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Engineering News-Record

A Consolidation of Engineering News and Engineering Record
McGRAW-HILL PUBLISHING COMPANY, INC.
SEPTEMBER 6, 1917

Six-Mile Water Supply Flume For California Irrigation Project.

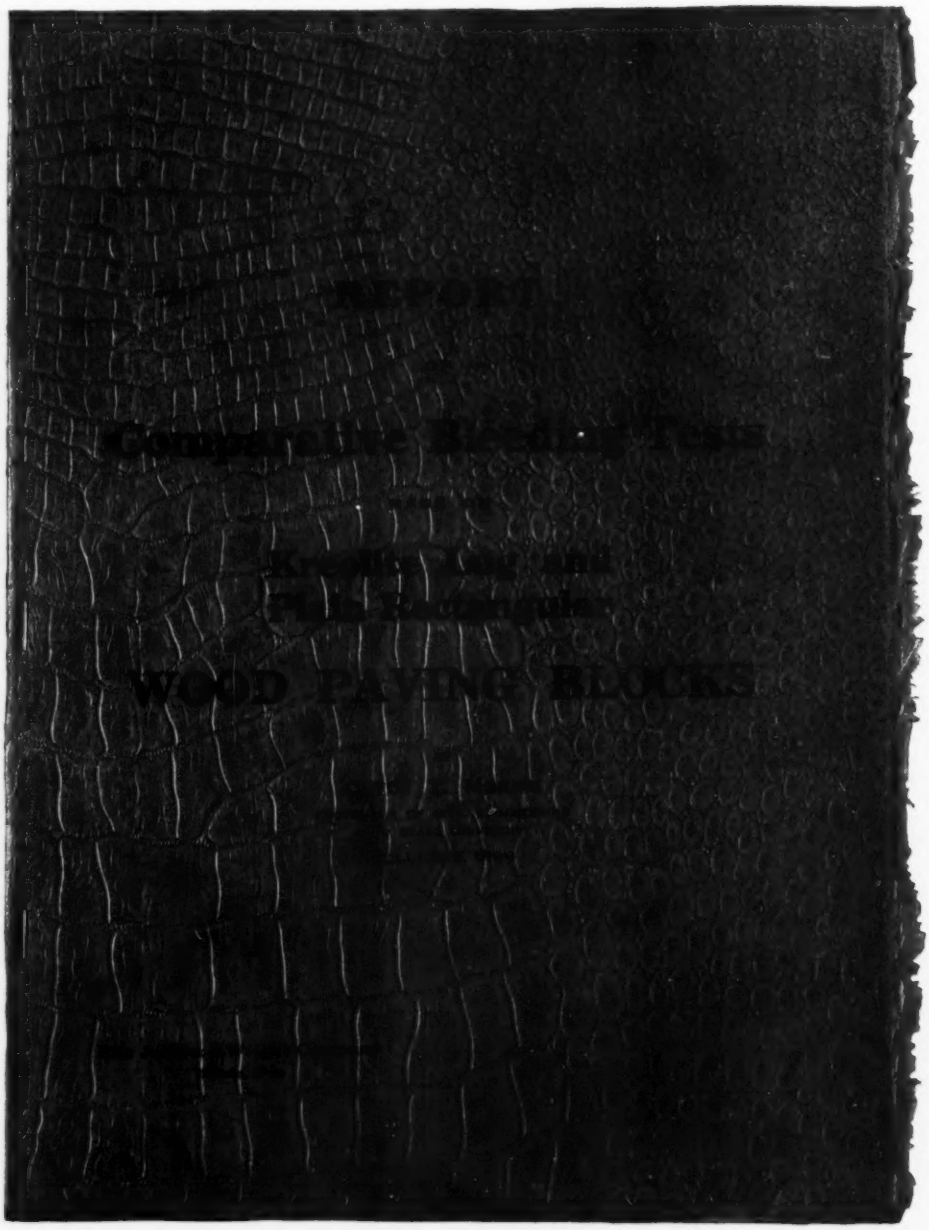
Water-Works Articles In This Issue: Surface Water Supply for Camp Dix—Large Well Sunk by Open Caisson Method—Filtration Controls Typhoid at Niagara Falls—Large Meter Measures Los Angeles Supply.

Cover released by courtesy of Universal Drafting Machine Co., Cleveland, Ohio.

Kreolite Lug Wood Paving Blocks
PREVENT BLEEDING

Proof of the Most Positive Nature

Compiled by Clyde T. Morris, *Professor of Civil Engineering, Ohio State University.*



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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
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AND CONTRACTING

Volume 79 NEW YORK, THURSDAY, SEPTEMBER 6, 1917 Number 10

Coöperation Among Water-Works Associations

THE growing spirit of coöperation among water-works associations is good to see. It has been shown chiefly by joint committee work. A notable example was the getting together of the American and New England committees on a tentative draft of cast-iron pipe specifications, which has the great merit of combining two "standard" specifications in one. All other committees of the two associations, created with the same general objects in view, might get together in like manner. This should be kept in mind at the meeting of the New England Water-Works Association at Hartford, next week.

What Next with Cast-Iron Pipe Specifications?

THE next move in the users-against-maker's deadlock over cast-iron pipe specifications, dealt with at length in *Engineering News-Record* of May 31 and July 19, falls to the New England Water-Works Association What that move should be depends largely upon whether the manufacturers continue to try to block the game or come on the stage like good sports, discuss the recommendations of the majority of the joint committee on their merits and accept the outcome in a spirit of true coöperation. One thing is certain: A single standard specification there should be. The appointment of manufacturers on the committees of the two associations shows a desire on the part of those who use pipe and pay the bill to get the benefit of their viewpoint, but not to give them choice between dictation and veto. *Engineering News-Record* looks for a change of attitude, a willingness to discuss and coöperate, on the part of the pipe makers at the Hartford Convention.

A Heated Question— Crematory, Incinerator or Burnery?

THE Cremation Association of America is said to have "again protested" against the use of the words "cremate" or "incinerate" to denote garbage disposal by burning. It urges that both terms should be confined to the cremation of human bodies. When it comes to burning, what does any human body care what term is used to describe the process? If the association persists that this is no light matter, it may be replied that, whatever the name used for the process, the end result is ashes. If the association still persists against garbage men using either crematory or incinerator when it has the high-sounding term crematorium all to itself, then it should submit a substitute. Why not burnery?

Machines Dig Camp Water and Sewer Trenches

TRENCHING machines for quick work! That was the conclusion of engineers and contractors at many of the army cantonments where speed in a world contest was the first requisite. One engineer reported a round dozen trenching machines in use at a single camp with another dozen expected on the scene in a few days. Imagine how 24 trenching machines would make the dirt fly! The variety of trenching machines in use was a striking feature of trench work at another camp. Every trench machine maker is being given an unexcelled opportunity to show what his machine can do. Hundreds of engineers and contractors and public officials are watching the game. Results are being accomplished and mentally noted which are bound to increase the use of trench machines on all sorts of ditch digging in future sewer, water, gas, drainage and irrigation work. If anyone finds time to keep cost records, so much more to the good.

Getting Around a Footless Law

FOR some reason one of the statutes of the State of Ohio requires that on public work bids must be asked for under three contracts: One, for furnishing all labor; two, for furnishing all materials; three, for furnishing both material and labor. For building work where a great number of appliances and fittings are used, there is a remote chance that this might effect some saving in eliminating contractors' profits on purchased material, but on engineering structures any attempts to separate labor and material will probably fail. Certainly few contractors would care to submit bids on labor and material which would add up to their bid on the total, even in the doubtful contingency that the dividing line between the two were well defined under the law. In one case, at least, the authorities recognize the futility of the law. The current advertisement for the new bridge at Akron is accompanied by a statement of the prosecuting attorney of Summit County to the effect that contractors on public work in Ohio are in the habit of bidding the same amount on

all three contracts. They are, then, according to the attorney, certain that if their bid is accepted it will be a bid for the material after it has been placed in the structure by means of the labor expended upon it, and the statement adds: "This method has been frequently followed and no objection has been taken to it."

Wanted—Hydraulic Data on Baffled Flow

OPERATORS of water-purification plants having highly baffled basins and also of sewage tanks with baffles and unusual-shaped courses of travel are finding that the designers' estimates of flow are not always realized. In the Baltimore sewage tanks the baffles are flooded out, and in the Cleveland water-purification plant the chemical-mixing baffles reduce the head so much that at least half of the number have been removed. A novel way out of the difficulty for a small plant was evolved at Napoleon, Ohio, by Clark & Goodwillie, of Toledo. Motor-driven ship propellers in a bell-mouth pipe were used to force the water backward from the forward compartments. About three times the nominal amount flowing is so moved, two or four compartments being used. Mr. Goodwillie states that the scheme works perfectly in a small plant, but he has grave doubts as to its practicability in a large one. Experiments on a small scale can be made at such testing stations as the one recently put into operation at the Detroit water-works, but operators in charge of large units where any unusual hydraulic conditions exist have an excellent chance to extend the engineers' fund of hydraulic information.

Henry Ford, the Road Promoter

THOUSANDS of acres of rich farming land in sections of Kentucky, Tennessee and West Virginia and some of the other southern mountain states are even today as absolutely inaccessible as they were when the country was settled 150 years ago. It is almost impossible to go east or west across the states of either Kentucky or Tennessee in a road vehicle. The chief concern of the state highway officials of these states is to interest the people in road improvement, for, once out of the urban valley sections, there is no road improvement sentiment. The mountaineers are content to exist just as they and their ancestors have existed for a century and a half ago. A great deal of good has been done by the Dixie, Jefferson and Jackson Highway associations in arousing local interest in getting a much advertised through route. But even the work of these associations would have amounted to little had it not been for Henry Ford, manufacturer of cheap automobiles; for local highway officials state that it was not until "flivvers" began to be owned and used in the mountains that the necessity of passable roads came home to the natives. Till then a pair of mules and a dilapidated wagon hauled over the stumps in the woods formed the only means of transportation which many of the natives had any knowledge of and certainly any experience with.

Much glory has been given this or that individual as the father of the good roads movement and as the original promoter of improved highways, but to Henry Ford belongs the honor and glory of having furnished the only good roads argument which hundreds of thousands of people in the backwoods sections of the country are capable of absorbing.

Illinois Public Works Not Headed by Engineer

OPPORTUNITY to place an engineer as head of the new Department of Public Works and Buildings was lost in the recent reorganization of the governmental administration of Illinois. This department has to deal essentially with engineering work. The advisability and advantages of appointing an engineer as the director of the department were presented to Governor Lowden, but he selected a lawyer for the position. It is no disparagement to the best of lawyers to say that they lack the technical knowledge necessary for the most efficient administration of such a department. A lawyer may have plenty of engineers under him, but their expert advice and recommendations are subject to the control of his inexpert knowledge and opinions.

Apparently the Governor held the antiquated and obsolete notion that the engineer is a super-hired-man employed to make calculations a. d plans, and to supervise work under construction. It is unfortunate that the Governor did not see that the engineer is by training and experience specially qualified for executive and administrative duties. Not every engineer, of course, has these particular qualifications, any more than every lawyer is qualified to be a judge. But there were plenty of engineers available who were competent to fill this position with benefit to the state.

War Upsets Utilities Appraisal

THE valuation of water-works and other public utility property has been demoralized by war. The actual value of the plants themselves has not been upset—that is to say reduced—but once accepted processes of finding out what that value is have become of uncertain worth.

Valuation of physical property has been based on, among other things, an inventory of tangible assets, a list of unit prices prevailing for the previous five or ten years, and judgment of the weight to be given to the product of these two factors. In the past two or three years the whole fabric of unit prices has been torn to shreds, and the foundations of judgment have been upset. While old economic and industrial conditions have been overturned, we have not yet established a new order. To illustrate, the cost of cast-iron pipe reflects the enormous demand for iron and steel products for munitions and ships. Cast-iron pipe will not always cost as much as it does now, but probably it will not return to its former basis for many years. Railways and industries have curtailed their demand for iron and

steel, but with the return of peace they will come into the market heavily to satisfy accumulated needs, and this will tend to prevent a rapid descent of prices.

The minimum below which the appraisal figure cannot descend seems to be fixed, for a long time to come, as a figure based on prices prevailing at the outbreak of war. The maximum above which the appraisals cannot rise may possibly be found if the Government continues its price-fixing far enough to cover the item of labor. What figure between these limits will be acceptable depends on whether "value" is defined as a rate basis or as a condemnation price, on what local conditions affect the claim of the owners to unearned increments, etc. The safest procedure at the present juncture seems to be to take the value based on prices at the outset of the war and to increase this value as judgment indicates will allow an approach to the stable basis of new peace prices. It must be recognized, however, that at best such appraisals must be uncertain. The situation calls for a tolerant spirit in all dealings between utilities and commission representatives of the public.

How Water-Works May Raise Trees as Well as Supply Water

THOUSANDS of acres of land are owned by the water-works of the country for the sanitary protection of their water-supplies. The area should be increased many-fold. Such lands produce water, but with notable exceptions they yield no crops. Cultivation of these water-gathering grounds would be objectionable for obvious reasons, and from the nature of the case would often be impracticable.

There is one crop that can be raised on water-works drainage areas without cultivation and with benefit rather than injury to the water-supply. Moreover, it is a crop requiring so long a period for its maturity as to make it far more practicable for a municipality or private corporation than for individual land owners. And it is a crop in constant and increasing demand at rapidly mounting prices. Trees, we hardly need say, are this crop.

The country over, a goodly number of water-works have gone into forestry. Some are making improvement cuttings, some are planting waste lands and others are doing both. In reforesting, considering both the number of water-works engaged and the magnitude of some of the operations, it is not surprising that New York State leads, for its Conservation Commission has been supplying nursery stock to all applicants at cost for half a decade and New York City has been reforesting its water-gathering grounds on a large scale. A summary of New York State operations in which the Conservation Commission has coöperated appears on page 463 of this issue. That New York State may soon be outdone by Pennsylvania, at least in number of water-works engaged in reforesting, may be seen by the statement in *Engineering News-Record* of May 10, 1917, page 297, that as a result of a campaign begun this year by the commissioner of forestry of that state, 26 water-works had put in orders for 446,000 seedlings to be supplied from the state nursery.

The Massachusetts Metropolitan Water District has done notable work in reforesting for a number of years past. Recently, the Baltimore Water Department has entered upon like work on a large scale. Among private corporations, the New Haven Water Co. has done much creditable work, both in reforesting and improvement cutting. It has a forestry department which devotes itself solely to growing and marketing trees. According to a paper by Prof. J. W. Toumey, director Yale School of Forestry, published in the *Journal* of the New England Water-Works Association for June, 1917, the New Haven Water Co. has a fixed policy of planting 250,000 trees a year and since it began collecting accurate data, nine years ago, has spent $37,000 on forestry work and is $9,000 ahead, after paying all expenses. From the discussion following Professor Toumey's paper, it appears that two other New England water-works, Holyoke, Mass., and Nashua, N. H., are alive to the benefits of forestry. In each case, the improvement of existing forests affords winter work for water-works employees who would otherwise be idle or forced to look elsewhere for employment. The various forestry operations of the Pennichuck Water Co. of Nashua were described and pictured in an article in *Engineering News* of Sept. 7, 1916, page 472. The examples of forestry work cited are only some out of many that might be named.

Although the direct money returns from reforesting are long deferred the first cost is small, the annual charges during the non-productive period are trifling and the ultimate revenue highly promising—especially in view of the rapid increases in the price of timber.

Almost immediate benefits come from reforesting. The surface of the land is protected from erosion, which alone would be of immense benefit in vast areas of the country. The seasonal run-off is equalized—however much or little floods may be lessened and the total water yields affected.

The choice of trees and methods for forestry work depends largely upon local conditions, demanding intelligent study. This need scare no community or water company from taking up forestry. Besides consulting and practicing foresters, there are in many states efficient forestry departments, eager to give advice or more substantial aid. The U. S. Forest Service stands ready to help in various ways. There are also a number of schools of forestry whose services may be enlisted, and there are books which may be had for a trifle and bulletins for the asking.

A more fascinating study and a more pleasureable occupation than forestry is hard to find. To the municipality or water company owning or whose bounden duty it is to acquire forested or forestable lands, growing tree crops deserves the most careful consideration—all the more careful in these days of decreasing timber and of increasing attention to everything that will protect and conserve public water-supplies.

New Jersey's Big Cantonment City Will Have Surface Water Supply

Fine Sand and Clay at Camp Dix an Objection to Wells—Pumping Plant Feeds Three-Mile Force Main—Both Cast-Iron and Wood-Stave Pipe Are Used—Many Trenching Machines at Work

By ROBERT K. TOMLIN, Jr.
Managing Editor, "Engineering News-Record"

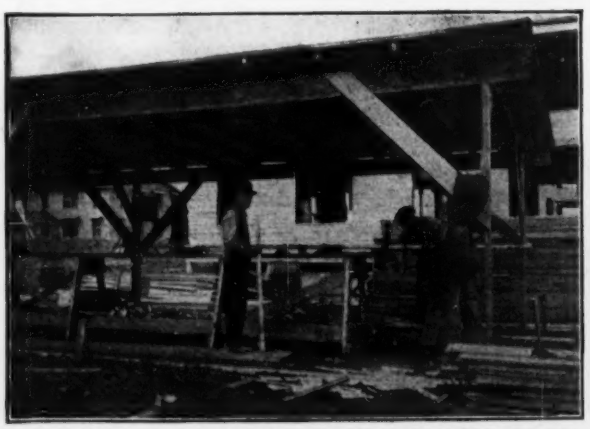
A SURFACE-WATER supply, instead of a ground-water supply such as is being installed at most of the other fifteen cantonments for the National Army, is the outstanding feature of the Camp Dix project at Wrightstown, N. J. When the plans for the camp were in the formative stage the intention was to secure water from artesian wells, but a careful study of ground-water conditions by Hazen, Whipple & Fuller, who were retained by Col. Harry O. Williams, Constructing Quartermaster, as engineers for the camp water-supply and sewerage work, led to the decision to take the supply, for the present at least, from Rancocas Creek through a cast-iron force main 17,000 ft. long to a point from which the distribution to the barracks and other buildings could be made through a system of wood-stave and cast-iron mains. As the camp site is elevated, the pumping lift is about 280 ft.

A Real Water-Works Problem

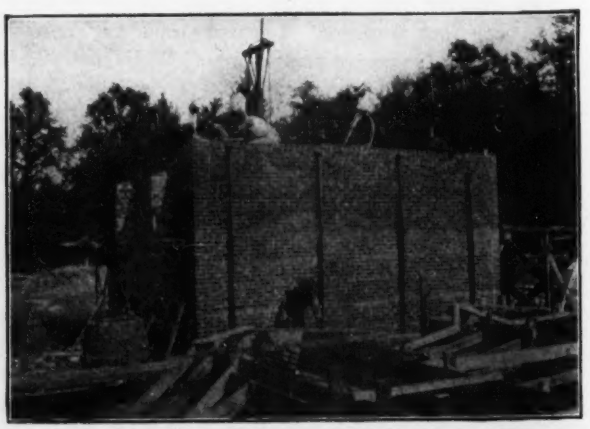
To one who has not visited any of the cantonments now under construction, the term "camp water supply" belittles the work that is being done. It suggests some makeshift project, requiring little, if any, real engineering—a job which any handy man can do. To gain a true perception of the water-supply problem, it must be realized at the outset that the so-called National Army "camps" are, in fact, full sized cities. When construction is finished, Camp Dix, for example, will need water for about 40,000 men and 25,000 animals. There will be block after block of wooden barracks, lavatories, administration buildings, storehouses, and various other structures all equipped with up-to-date plumbing fixtures, and requiring water for fire protection. The engineer's estimate placed the average daily consumption at 2,500,000 gal., but the system is designed for a peak load at the rate of 7,500,000 gal. daily for short periods. As far as the water supply is concerned, therefore, one must think, not in terms of the old town pump, but of municipal water-works on a large scale.

Fine Sand An Objection to Wells

Although the camp site is located on sandy soil, with water obtainable from deep wells, the sand is very fine, having a size of only about 0.11 mm. and is cut by bands of impervious clay and marl. This condition, Mr. Hazen concluded, would be unfavorable for a ground-water supply, inasmuch as the fine material would seriously impede the underground flow to the wells during periods of maximum draft. At Camp Upton, N. Y., described in *Engineering News-Record*, Aug. 23, page 340, the Long Island sand grains are of much larger size than those at Camp Dix, and conditions for a



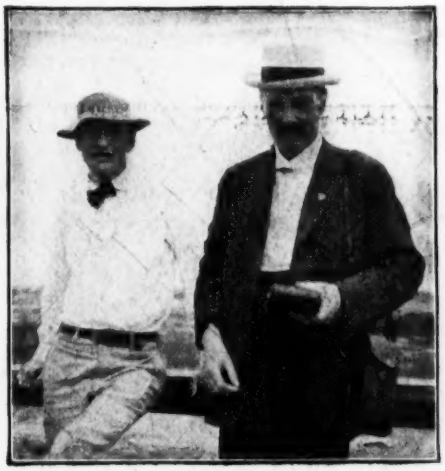
FIELD SHED UNDER WHICH PLUMBERS THREAD PIPE AND ADJUST HOUSE CONNECTIONS



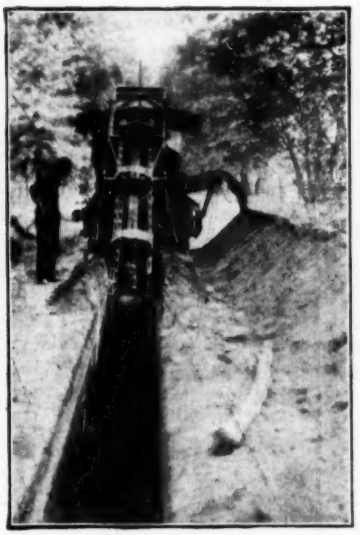
BUILDING SETTINGS FOR BOILERS AT THE MAIN PUMPING STATION ON RANCOCAS CREEK

Installing the Water-Supply System at Camp Dix, N. J.

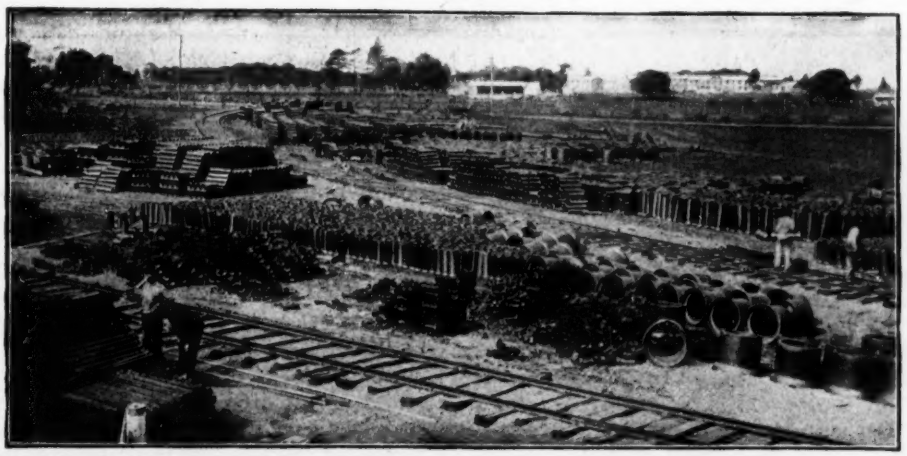
CAST-IRON FORCE MAIN WHICH CARRIES THE MAIN SUPPLY



ALLEN HAZEN (RIGHT) AND HIS PARTNER, WESTON E. FULLER, WHO ARE IN CHARGE OF ALL WATER-SUPPLY AND SEWERAGE WORK AT CAMP DIX

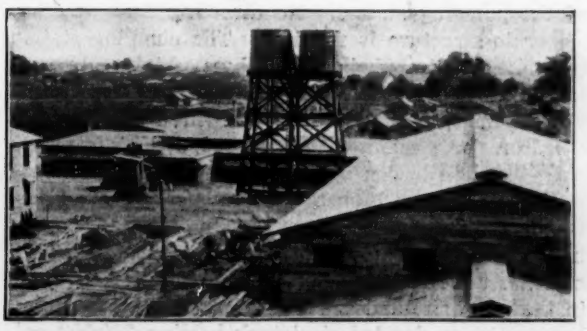


MANY TRENCHING MACHINES ARE USED ON THE WORK

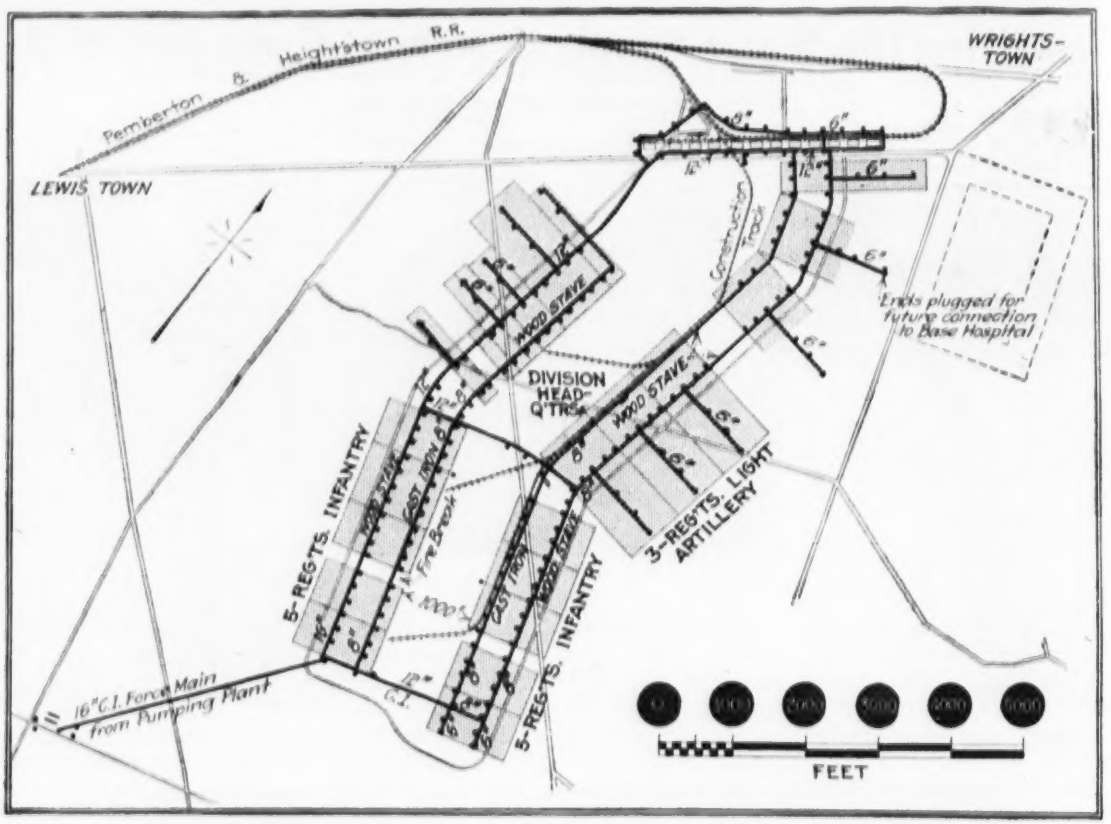


TILE PIPE FOR THE SEWERAGE SYSTEM, AND CAST-IRON AND WOOD-STAVE PIPE FOR THE WATER-SUPPLY ARE UNLOADED AT A STORAGE YARD NEAR THE RAILROAD SIDING

PIPE LAYING FOLLOWS CLOSELY AFTER THE TRENCHING MACHINE



THESE ELEVATED TANKS ARE FOR TEMPORARY FIRE PROTECTION



CAMP LAYOUT, SHOWING THE WATER MAIN CONNECTIONS

ground-water supply are almost ideal. Then, too, the time element at Camp Dix was a consideration of prime importance. Troops were scheduled to arrive early this month, and the water supply had to be ready for them. Artesian wells would have to be several hundred feet deep to strike suitable water-bearing strata, and much time would be required to drive them. Information as to the required depth was furnished by State Geologist Kummel, who has for years collected data in regard to New Jersey wells, and his judgment has been confirmed by one test well authorized at the start and which has not yet reached its full depth.

Water-Works of Simple Design

Simplicity is the essence of the water-works design at Camp Dix. The intake at Rancocas Creek is merely a short length of pipe extending into the suction well of the pumping station. No diverting dam or other elaborate structure is required. The pumping station comprises duplicate boilers, and three centrifugal pumping units, each with a capacity of 1,500,000 gal. per day. These pumps, as previously noted, deliver into a 16-in. cast-iron force main, 17,000 ft. long. This connects with the distribution system, consisting of four main lines with various branch lines and cross connections, the pipe ranging from 6 to 16 in. in diameter, extending through the camp site for a distance of about 2 miles. At the further end, at one of the highest points in the camp site and about 5 miles from the pumping station, is an elevated steel tank holding 200,000 gal. A Venturi meter will record the flow at the pumping station and liquid chlorine apparatus of the Wallace & Tiernan type will be installed to sterilize the raw water, although the drainage area of the creek, about 72 sq. miles, is nearly uninhabited and the chances of pollution are small.

Both Wood-Stave and Metal Pipe Used

Although the original intention was to use wood-stave pipe exclusively for the water-works system, delays in delivery of this material, which was shipped from the Pacific Coast, made it necessary to purchase supplies of cast-iron pipe in local markets, in order not to delay the work. The wood-stave pipe is now being received and laid. The regular procedure on the cantonment contracts is for the larger supplies to be purchased through a central bureau in Washington. When wood-stave pipe failed to arrive, the Washington authorities ordered cast-iron pipe from various foundries. Specials and other supplies were ordered in part in the same way, but as the work has proceeded such supplies have been located by the engineers wherever they could be purchased for the quickest delivery. Some of the pipe that is used is pipe that has been rejected for minor defects by certain city water-works departments for which they had been made and has been accepted for the camp work where it was essentially sound and suitable for temporary service. In one case a special lot of pipe was purchased at considerably less than the usual rate.

There is nothing special about the laying of the cast-iron mains unless it be that practically all of the trench

JOINTING THE 16-INCH FORCE MAIN

work is done by machine. There are a number of Parsons, Austin, and Buckeye outfits on the work of trenching both for water main and sewers. The minimum earth cover over the water mains is 3 ft.

How Wood Pipe Is Laid

The wood pipe is from 6 to 16 in. in diameter. It is laid in a trench only slightly larger than the pipe, some places not more than 4 in. wider than the normal diameter of the pipe. The joints are made by driving the spigot end into the wooden socket which is made like the pipe, being wound with wire. Before driving the pipe a wooden plug is placed in the open end so as to protect the pipe. The driving is done by two men swinging a heavy log used as a maul. The men stand above the trench with ropes attached to the maul and swing it back and forth several times before striking the plug in the pipe. The operation is repeated until the shoulder of the spigot comes home on the socket.

Connections with the hydrants and at the junctions of pipe lines are made by using ordinary cast-iron specials, into the ends of which are placed special bell and spigot pieces of cast-iron pipe about 2 ft. long. The bells on these pieces have straight and smooth sides to receive the spigot of the wood pipe. Special precautions were taken to have these bells true to size and shape and smooth; graphite is used on the cores in order to secure a smooth surface.

Service connections are made by inserting into the wood an ordinary corporation cock made with a wood thread. Several bends are placed on the service pipe immediately following the corporation cock in order to give flexibility and to prevent contraction or movement of the service pipe disturbing the joint between the corporation cock and the wood pipe. Slight curvature of the lines is made in the wood pipe bends; where greater bends are required, cast-iron specials are used.

The entire water-works system will require about 90,000 ft. of pipe 6 in. and larger, of which approximately two-thirds will be wood-stave and one-third cast-iron. Connections between the wood and metal pipe will be made by a special casting about 24 in. long. All of the stave pipe is of redwood from the State of California, and is wire wound at the point of manufacture. There will also be about 8500 ft. of galvanized steel pipe 2 in. and smaller for service connections.

As a measure of protection in case of fire, and for meeting conditions of maximum consumption, an auxiliary pumping plant has been established on the camp grounds. It consists of two centrifugal pumps and three wooden tanks each of 200,000 gal. capacity. The tanks are elevated and occupy a small knoll, which is the highest point of the area to be served with water.

This system will not ordinarily be used, but is held for emergencies. The tanks are not high enough to give a working pressure, but in case of need the pumps will be started and the water held in reserve forced into the pipes.

Personnel

Assisting Mr. Hazen in the design and supervision of the Camp Dix water-supply and sewerage work, is his partner, Weston E. Fuller, who is acting as resident engineer on the work, supported by a corps of assistants recruited from the New York office of the firm and elsewhere, and including several experienced water-works men who are glad to do their bit in this way. Colonel Williams, Constructing Quartermaster, had general supervision over the entire camp construction project up to Aug. 22, when Capt. T. H. Skinner, his able principal assistant, succeeded him.

Gives a New Method of Making Right-of-Way Computations

By P. E. Stevens
Consulting Engineer, St. Paul, Minn.

In the issue of July 12, 1917, p. 84, a long table is published as a shortcut for finding the length along the right-of-way line, where the corresponding length along the center line is known. This is doubtless quicker than the old method cited (I have never tried this old one) but why use any such "old method"?

If D is the distance along the center line of the curve, A the angle of deflection in degrees between the tangents at the two ends of D, and O the offset to the right-of-way or other parallel line, then the distance along said parallel may be found from the following formula:

$$x = D \pm \frac{\pi AO}{180} = \frac{AO}{57.2958} = 0.0175AO$$

Applying this to the example given by Mr. Sanow, we have the following data: $D = 254.9$, $A = 12.103$, $O = 33$ ft. Substituting,

$$x = 254.9 \pm \frac{12.103 \times 33}{57.3}$$

and by using a 10-in. slide rule we find (in about 30 sec.)

$$x = 254.9 + 6.97 = 261.87$$

or

$$254.9 - 6.97 = 247.93$$

Comparing this with the result obtained by your correspondent, we find a typographical error. Investigation shows that the value of x does not agree with log x, and should be 261.872 instead of 261.787 as given. given.

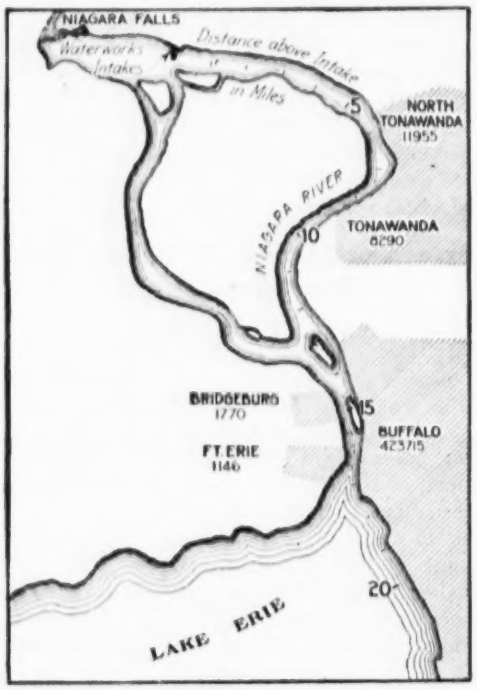
It will be observed that the formula given here does not contain the radius of curvature. It therefore applies without modification to any curve of any radius or any combination of compound or reverse curves, or to curves connected by easements or by intermediate tangents, or to distances measured partly on tangent and partly on curves. Moreover, this formula can be solved in about forty-five seconds with a 10-in. slide rule, giving in most cases two decimal places.

Filtration Controls Typhoid at Niagara Falls

Mechanical Filters and Hypochlorite Reduce High Typhoid Rate to Minimum and Save $500,000 Yearly

By Charles B. Burdick
Of Alvord & Burdick, Sanitary Engineers, Chicago

IN a long list of discreditable typhoid records, that of Niagara Falls, N. Y., in times past was one of the worst. Since the introduction of water filtration in 1912, typhoid practically has been eliminated. The raw water is so heavily polluted, and the benefits from its purification have been so marked, that it will be worth while briefly to record the conditions that surround the problem, the degree of the pollution, and a measurement of benefits brought about by filtration and chlorination.



THE POPULATIONS SHOWN ARE LOCATED 5 TO 20 MILES ABOVE THE WATER INTAKES OF NIAGARA FALLS

To the casual observer, the pollution of the Niagara River is not evident. Generally, the water has a good appearance. It is only turbid after protracted gales on Lake Erie. It is, however, more heavily polluted with fresh sewage than any other water upon the Great Lakes system, and there are few places in this country, if any, where water of heavier contamination is purified for the supply of a municipality.

The City of Niagara Falls is supplied by two waterworks systems, both deriving their supplies from the river. Both plants treat the water by mechanical filtration, and both filter plants went into service in the year 1912. The greater part of the city is supplied from the municipal plant, the intake for which is well above the city. (See map.) The water is taken out 2000 ft. from shore, substantially in mid-stream. The New York Water Co. draws its supply from a power canal near the center of the city. Both intakes are above the outlets of the local municipal sewers.

Extent of Pollution

Within twenty miles upstream from the intakes, the sewage from nearly half a million people reaches the river. The average flow of the Niagara River is some 210,000 sec.-ft. or about 470 sec.-ft. per 1000 population. From the nuisance standpoint the pollution is negligible. The time of travel from sewer outlets to water intakes averages less than 24 hours, and the filters doubtless handle a very large number of dangerous germs.

As would be expected, the heavy pollution is evident in the analyses of the raw water. The International Joint Commission, in its progress report of 1914, on the pollution of boundary waters, contains a series of observations upon this water. Below Buffalo, and above the Falls, the pollution is quite variable, and, although heavy everywhere, it is not evenly distributed, but varies in intensity and in location, depending principally upon the wind, particularly the Lake Erie storms.

For comparative purposes, the Commission has compared the polluted waters by the so-called Phelps method, the principal basis of comparison being the number of B. coli per 100 c.c. of water. In the vicinity of the Niagara Falls intake, B. coli is always present in numbers ranging from 150 to 20,000 per 100 c.c. Probably the heaviest pollution generally passes between the intake and the shore, for it nearly all reaches the river on the American bank, and the sewage evidently is not very thoroughly mixed with the water until after passing the falls and the rapids below the water-works intakes.

Water-Filtration Plants at Niagara Falls

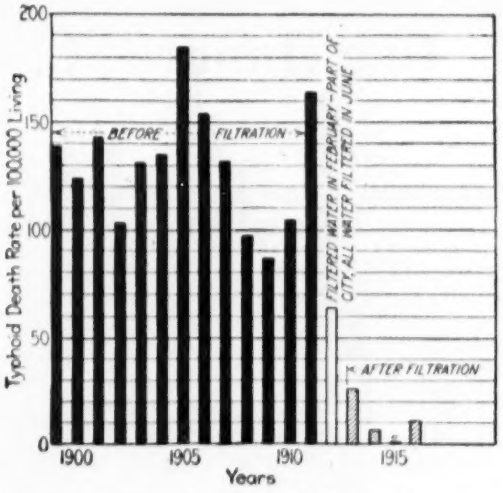
There is nothing out of the ordinary in the water-filtration plants that have accomplished the great typhoid reduction at Niagara Falls. Essentially, they are similar to the modern gravity mechanical filtration plants that have been so successfully applied to American waters during the past fifteen years.

The municipal plant has a capacity of 16,000,000 gal. per day, and is operated very closely to its rated capacity. The tremendous use of water is in part accounted for by the very heavy industrial consumption in the electro-chemical works utilizing the available cheap electricity. No doubt there is also a very large waste. The water is treated with sulphate of alumina and subsided for an average period of three hours, treated with hypochlorite of calcium, filtered, and then pumped to the distribution system by direct pressure without exposing the water to the atmosphere. The plant was built by the Norwood Engineering Co., Florence, Mass., under the advice of Alvord & Burdick, consulting engineers. W. D. Robins was resident engineer for the Water Board during construction. The plant is operated under the direction of a resident bacteriologist and chemist.

The filtration works of the New York Water Co. are similar to those of the municipality. The water is treated with alum and hypochlorite. The filters are of the reinforced-concrete gravity type.

The typhoid statistics speak for the result of water filtration. For more than ten years prior to 1912, there had never been less than 22 and from that to 55 deaths per annum in a city which grew from 17,000 to 33,000 in population during the period before the introduction of filters. The average typhoid mortality for the period 1899 to 1911 was 131 per annum per 100,000 living population.

The entire city was not supplied with filtered water until the middle of 1912, but the effect upon the typhoid death rate was immediate (see diagram). In 1915 there was not a single death from typhoid fever in the City of Niagara Falls. No deaths occured in 1917 up to May. In the four years following filtration, the average death rate has been 11 per 100,000 of people living. Half of these deaths occurred the first year after filtration was installed. In the past three years there have been eight deaths, which is an average mortality of 5.3 per 100,000 of living.



FILTRATION AND HYPOCHLORITE SENT TYPHOID WAY DOWN AT NIAGARA FALLS

Results Expressed in Money

With the present population of 50,000, and the typhoid death rate for four years preceding filtration (113), there would be an average of 57 deaths per year. The average number of typhoid deaths in the present city of 50,000 people since the installation of filtration, has been a fraction less than six, thus effecting a saving of 51 lives per year, which, at $10,000, would amount to $510,000 per year.

Oregon Will Limit Use of Water for Irrigation

Following Engineering Advice State Water Board Correlates Use of Water with Actual Irrigation Conditions

By Percy A. Cupper
Assistant State Engineer, Salem, Oregon

In *Engineering News* of July 6, 1916, there appeared an article entitled "State Engineer's River Survey Guides Water Adjudicators," which was descriptive of a survey and investigation of Wallowa River and its tributaries. It was pointed out that the report based upon this survey and investigation could, and probably would, be the basis of the determination of the relative rights to the use of water.

At a recent meeting the board entered its findings determining the nature, extent and priority of all rights to the use of the waters of this stream. It is interesting to note that the engineering report was followed in practically every detail, notwithstanding that it called for what is believed to be an unprecedented limitation on the use of the water. It was found that rotation was practiced under the larger ditches, and also that the aggregate capacity of the ditches exceeded the flow of the stream during the irrigation season. To fix the head of water to be diverted would prevent the irrigators from continuing their present practice of irrigation, and would also prevent the use of the peak of the floods which required the maximum capacity of all ditches to handle.

In order to take care of this situation it was determined that not to exceed 1½ acre-feet per acre should be diverted during any period of 30 days prior to Aug. 1 of each year, and during the remainder of the irrigation season not to exceed 1 acre-foot per acre. This limitation is applicable to only a part of the stream system, most of the remainder being limited to 1 acre-foot per acre in a period of 30 days prior to Aug. 1, and 1 acre-foot thereafter; while from one stream of regular flow the rights are limited to $^1/_{50}$ cu.ft. per second per acre. The irrigation season extends from May 1 to Oct. 1.

While this might seem to indicate a very low duty of water, very little use is made of the water during May except in unusual seasons. By fixing the maximum amount in acre-feet, greater flexibility is given to the distribution of the water by the administrative officials having this in charge. It is thus possible to utilize the full capacity of the ditches and make use of all water that is flowing in the ditches up to the full capacity of the canals. The use of water by rotation is also made possible.

This is the first decree entered by the State Water Board of Oregon in which a limitation has been placed on the quantity of water to be used in any period less than the entire irrigation season, except as it has been fixed by a limitation on the rate of flow. It is believed that the finding of the Board in this case has taken into account actual irrigation conditions to an extent not heretofore attempted. This has been made possible through the reliable engineering information secured, which goes to show the importance of accurate engineering data in the judicial determination of questions of this nature.

Nebraska Has State-Aid Road Plan

All the roads that are to be built in Nebraska in 1918 with the assistance of state and federal funds have now been located. The total estimated cost is $1,200,000, and it is expected that the state will be ready to award contracts in January. County-bridge contracts to be let in October aggregate $218,000, of which half will be paid by the state. Geo. E. Johnson, of Lincoln, Neb., is state engineer.

One Hundred Concrete Dwellings Built as One Contract Job

Standardized Designs, Steel Forms and Contract Methods Similar to Those Used on Large Construction Permit Completion of One House Every Three Days

EVER since Thomas A. Edison electrified the lay world a few years ago with the announcement that he was going to pour a concrete house complete in an hour or so, the possibilities of rapid and cheap group dwelling construction have had a popular appeal. Unfortunately, most of the efforts along this line have been little more practicable than was Mr. Edison's scheme, but in Donora, Penn., the Aberthaw Construction Co., of Boston, Mass, is now successfully completing for the American Steel and Wire Co., a group of concrete dwellings which are at the same time cheap, serviceable and of good appearance.

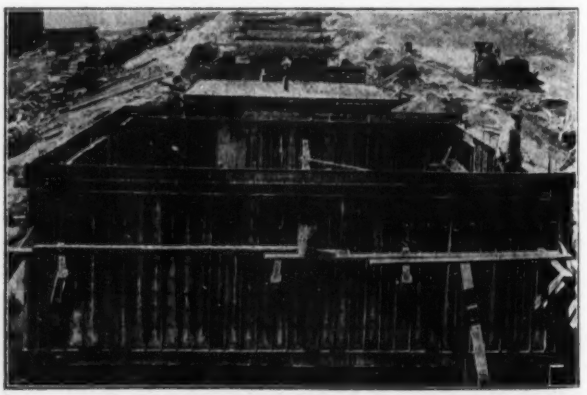
The success of the work is due primarily to the application of orderly contract methods to a design which was well worked out in the first place. The contractor did not come on the job until after some few houses had been completed, at great trouble and expense, by a contractor of less experience. So it is fair to assume that the methods now used are of at least as much importance as the original design. In fact, the contractor considers that in future developments changes in design could be profitably made.

Eight Types of House All Somewhat Alike

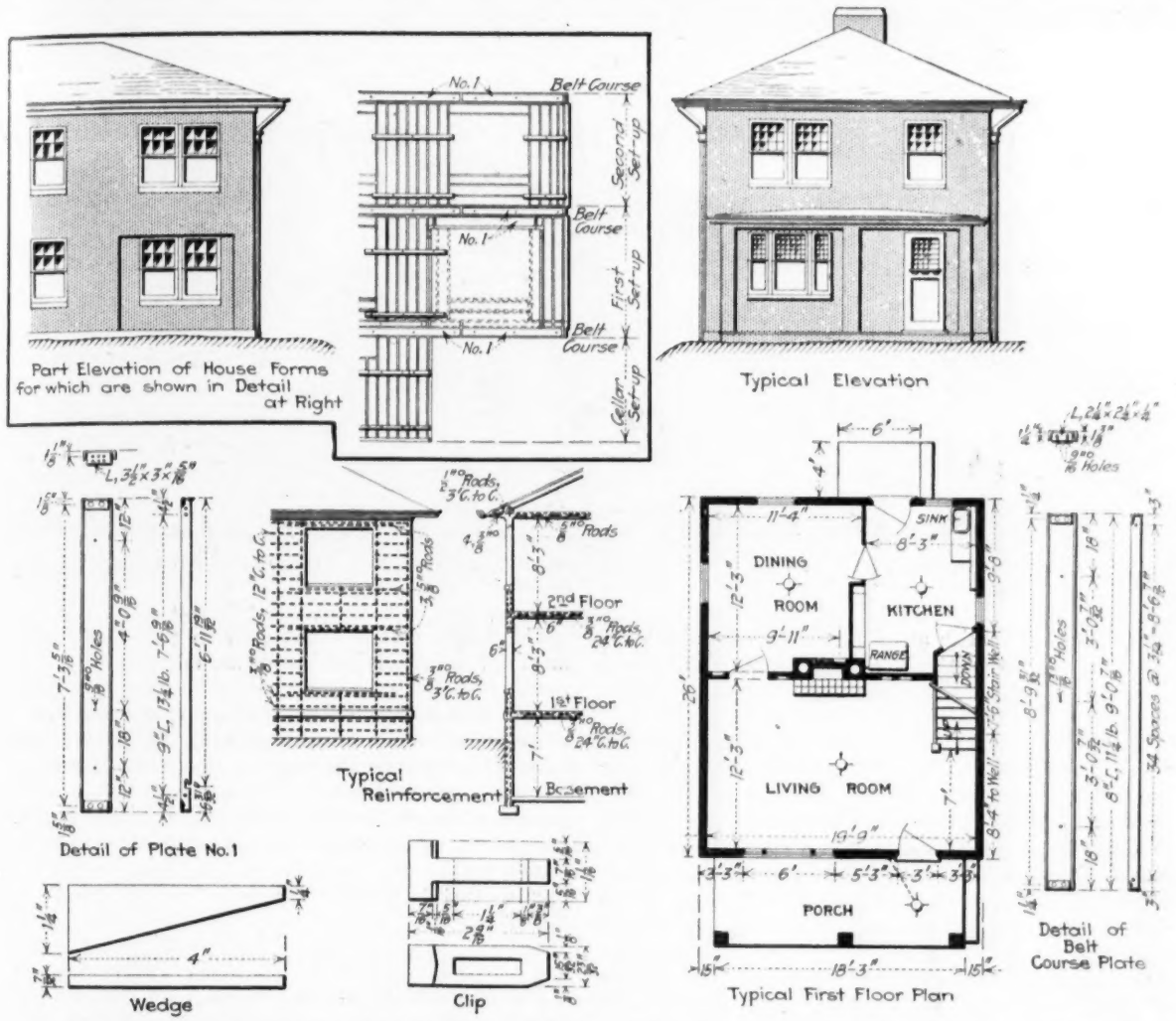
The site of the development is about 40 miles outside of Pittsburgh and is located on a steep hill above the Monongahela River. The property has been laid out into 156 lots, of which 100 are now being built upon and the remainder will follow next year. Grading was done and streets laid out by the American Steel and Wire Co., concurrently with the house building. The streets will all be paved with concrete, and granolithic sidewalks will be laid

The houses were designed by the Lambie Concrete House Corporation, of Boston, Mass. Eight different styles of houses are being built, containing some four, some five, and some six rooms, all with a bath and cellar. Of these, a few are being built in pairs with party walls, and the rest are all detached. The contract prices for a house complete range from $2000 to $3300, but such costs are based on prices of some time ago and can hardly be used for present comparison. The costs include gas furnaces and cooking ranges, electric lighting and the usual improved kitchen and bathroom equipment. The average floor area is 26 x 26 feet.

Typical house layouts are shown. They are all of the box type with 6-in. solid concrete walls reinforced vertically on both faces and horizontally on the outer face with straight rods, with an intermediate partition wall cutting down the floor spans to 12 to 15 ft. The floors are of the ribbed reinforced-concrete type, with the ribs or beams spanning between the outer and interior walls. These ribs are left exposed in the cellar, but in the other floors plaster board is nailed to strips left in the concrete and a finish plaster coat made. The buildings are finished at the top with a reinforced-concrete cornice in which a gutter is formed, and on top of the concrete ceilings a roof is built up of spruce framing covered with asbestos slate so that the whole



LOOKING UP A ROW UNDER CONSTRUCTION



HOW THE HOUSES WERE DETAILED AND REINFORCED AND HOW THE STEEL FORMS WERE APPLIED

of the exterior of the building, with the exception of this frame, the wooden window and door frames, and wood stairs, is fire-resisting.

Special Steel Forms Effectively Used

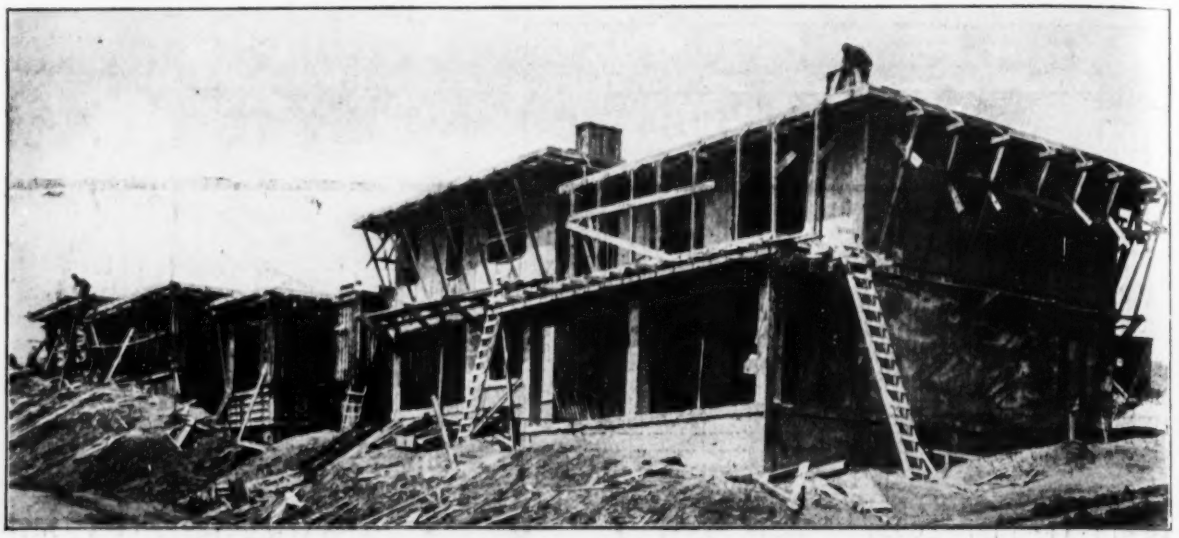
An important factor in the effectiveness of the work is the forms. These are of the special steel channel type patented by the Lambie Concrete House Corporation. They consist of 9-in. channels set up vertically and connected together with clips and wedges passed through slotted holes in the flanges of the channels. At the corner of the building a 4 x 4-in. steel angle is set up, and the forms are lined up longitudinally by means of a steel channel used to form a belt course. This not only fastens the forms of the lower floor, but is bolted into the floor reinforcement and remains in place for a support for the second-story forms and is only stripped at the last when all the concrete is poured. The steel wall forms also support the floor forms, which are steel domes, arrangement being made by which the steel channels on which the domes are laid are bolted to the inner side of the steel wall forms. The cornice has to be built inside special wood forms supported, as shown in some of the views, by wooden struts reaching down to the belt-course channel form.

The cellars were excavated with a steam shovel which went down a street, taking out a strip the depth of the houses. The space between the walls of the houses is backfilled after the cellar walls are placed. The digging was in hardpan with some shale, but all of it was taken out by the steam shovel.

Forms Moved from One House to Next

The construction of the houses proper is done in groups, to fit the number of sets of forms, which are taken down as soon as possible and moved on to the next group.

The usual method is to set the forms for one story—wall and floor together—and then to pour the concrete for this section all at once. The progress of the job is limited by the setting of the concrete. To form, pour and strip each story takes about seven days. Working at this rate, the house of two floors and cellar is completely concreted in three weeks, and with the twelve sets of forms on the job, twelve houses are concreted in this period. After this the plumbing, heating, plaster-



FORMS ARE USED ON ONE ROW AT A TIME. CORNICES HAVE TO BE SUPPORTED ON STRUTS DOWN TO BELT FORMS

ing, roofing and finish are done, which take about five weeks more, so that the houses are being completed at the rate of twelve in the first eight weeks and twelve every three weeks thereafter.

During the months of May, June and July the progress made was as follows: 28 complete houses (counting double houses as one) were concreted in 12½ weeks, or at the rate of a house every three days. In the last month quite a number of houses were concreted very quickly—that is, from the day starting erecting basement wall forms on the footings, to and including the day the roofs were concreted. The last houses have gone up as follows: Two in 13 calendar days, one of which could have been done in 12, except for shortage of sand, 2 in 14 days, 5 in 15 days, 2 in 16 days, 2 in 17 days, 3 in 19 days, 1 in 20 days, and 1 in 21 days. Under ordinary conditions these houses could have been built with one set of forms.

Concrete Tower Replaced by Small Hoists

In the original contract for the houses, concrete was placed from a high stationary tower, with a chute. This proved inefficient, because of the number of moves that had to be made to control the whole housing area. There is so small an amount of concrete in each house, 125 cu.yd. on the average, and the houses are so scattered that the cost per yard of concrete was materially increased by the cost of the tower erection and construction. After a long study of different methods the Aberthaw company decided on small mobile concrete mixers, which could be placed alongside each house during concrete placing, and small hoists on each building.

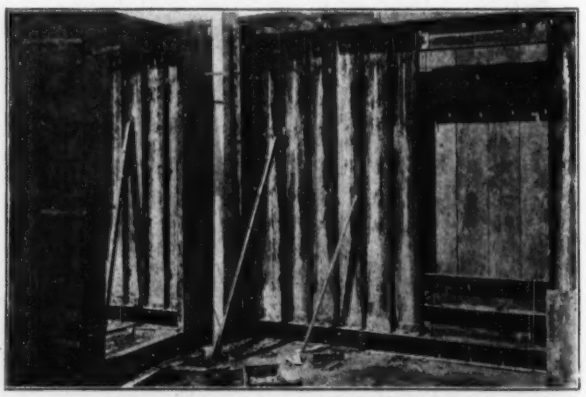
The plant consists of three Koehring "Dandie" one-bag gasoline-driven mixers, two of which are equipped with side loaders, three Sasgen circle swing derricks; two Novo gasoline-driven hoists, which control derrick and mixer. The slag aggregate, and sand, as well as the cement, are delivered to the mixer by means of a truck which brings the material from Aberthaw's unloading yard, located in the yard of the American Steel and Wire Company.

The Sasgen derrick is not used for pouring the basement and first floor, but is used for all concreting above that. It is bolted securely to the best course on one corner of the building, and the concrete is hoisted in concrete buggies or wheelbarrows. Better results have been obtained with the buggies than with the wheelbarrows. Each wheelbarrow has a hook bolted to the front end and is lifted by the derrick by means of three steel arms with rings on the ends, two of which hitch to the handles and the third into the hook on the barrow, so that it is lifted completely and level onto the floor.

How the Organization Works

The organization on the job is a superintendent, assistant superintendent, civil engineer, material clerk, two cost clerks, timekeeper, planning department and stenographer. The formwork is under supervision of one carpenter foreman, five squad bosses, two stripping foremen, two move foremen, one reinforcing steel boss, one finish carpentry boss, three concrete bosses and one excavation boss.

It was found advisable to have a squad boss in charge of the carpenters and helpers working on each house.



STEEL CHANNELS BOLTED TOGETHER USED AS FORMS

This boss has four carpenters and four helpers on the smaller houses; and on the large double houses, up to seven carpenters and seven helpers. The work has been most economically done when the carpenters and helpers worked in pairs—that is, each carpenter has a helper to assist him in moving the forms, etc. It will be noticed that the reinforcing steel boss comes under the carpenter foremen. This has been found desirable, as the steel must be placed rapidly whenever the carpenters are ready for it. The planning department on the job lays out progress each day for the next three days and shows which foreman is to erect forms on each house and which concrete gang will pour them.

ON LEFT, EARLY METHOD OF SPOUTING CONCRETE FROM TOWER. ON RIGHT, LIFTING CONCRETE BARROWS BY DERRICK ON HOUSE FORM

Five Carpenter Gangs Erect Forms

The number of men in a concrete gang varies from 13 to 15, according to the type of house and the amount of concrete to be poured. The number of gangs at work at the same time is five carpenter gangs erecting forms, two concrete gangs concreting forms, two stripping gangs stripping forms, one concrete gang concreting footings, pavings, porch floors, floor steps, chimneys, etc., one digging gang, and one finish carpentry gang, doing the furring, roof framing and roof boarding, erecting door and window frames, sash doors, inside and outside trim, stair laying, floors, etc.

On a large-type 6-room house group this force has taken approximately 1½ days to erect basement walls and first-floor forms, including all boxes, window frames, flues, etc. Concreting basement walls takes about 2½ hours, and 1½ hours to pour the floor. Stripping and erecting the basement wall forms on the first story takes 1½ to 2 days. The stripping of the first-story walls and erecting the second story and putting on the floor takes about 1½ days, but the putting on of the cornice is a slower operation and adds from half a day to a day to this. Concreting the walls takes about 2½ hours, and the roof about the same length of time.

Detail Costs Are Given

The steel reinforcement varies from 1½ tons in the smallest type of single houses to three tons in the largest type of double houses. The labor on wall steel has cost to date $11.90 a ton and the floor steel or beam steel $7.50 a ton. The cost of labor on wall forms to date has been $4.30 a hundred square feet and the stripping has been $2.10. This does not include the moving of forms onto the lots, which has cost about $55 per house, or about $1.25 per 100 sq.ft. of wall.

The quantities of concrete per house vary from 145 cu.yd. for the largest double house down to 85 for the smaller single houses. This includes all walls and floors, footings, pavings, porches and chimneys. At the present time it is costing about $2.25 per cu.yd. to place the concrete in the first- and second-story walls, which are 6-in. walls, and it costs the same for the floor slabs. The smaller houses have about 15 cu.yd. of concrete in the first- or second-story walls, and 6 cu.yd. of concrete in the first and second floors. The roof, including the cornice, has about 10 cu.yd. The cost of erecting the formwork, including handling, stripping and cleaning, is averaging about 50c. per sq.ft. As no lumber is required for the wall forms, this is doubtless considerably cheaper than work of this class could be done in wood.

Water-Borne Typhoid at Charleston

The water-supply of Charleston, W. Va., is held responsible for an outbreak of typhoid fever in that city in May and June, 1917, according to a report by Dr. A. W. Freeman, epidemiologist, U. S. Public Health Service, printed in *Public Health Reports* for Aug. 17.

Associated with Doctor Freeman in the investigation of the outbreak were Earle B. Phelps, professor of chemistry, and E. E. Smith, sanitary bacteriologist, U. S. Public Health Service, and Dr. H. B. Wood, assistant commissioner of health of West Virginia. From May 1 to June 25, typhoid cases numbering 127 were reported or discovered, of which 12 were diagnosed as typhoid by the attending physicians and seven as paratyphoid or probable paratyphoid. The only common source of probable infection was the public water-supply. Sections of the city supplied by private wells "were markedly free" from typhoid, as were sections which were "unsewered, and in which surface privies are common." The investigators recommended that a competent bacteriologist be employed by the city, that the operation of the water-works be put in his control, that coagulants be applied daily at the filtration plant and that the water be treated with about 0.5 p.p.m. of chlorine.

Large Blast Accurately Places 897,000 Tons of Rock

Proportioning a 48-Ton Explosive Charge To Shatter Quarry Face Deeply Without Loss of Material at Corona, Calif.

THE Temescal Rock Co., of Corona, Calif., in a single blast recently broke up 897,000 tons of rock for its crushing plant without losing any of the shattered material over the edge of the 100-ft. bench that serves as the quarry floor. This was accomplished by a system of tunnels so driven that charges of quick-acting explosive would throw out the toe of the quarry face before the force of the remainder of the 48-ton charge was developed. Thus a barrier was formed which served to retain the major portion of the shattered material.

The rock from this quarry is crushed for use in concrete and is an altered rhyolite of eruptive origin, very dense and hard. The formation was solid, the strata inclining into the quarry face at about 16°. Tests of quarry specimens showed a weight of 167 lb. per cu.ft. and tensile and compressive strengths 2245 and 39,500 lb. per sq.in. respectively.

Location of Charges

The duplicate tunnel systems were driven at the quarry-floor level, in each of which 18 explosive charges were placed. The tunnels were 3 x 3½ ft. in section and all powder pockets were of such size as to allow 1⅛ cu.ft. of space for each 100 lb. of powder in the charge. The tunnels were driven 140 ft. into the quarry face, and the charges were placed in drifts at right angles to the tunnels, as shown in the accompanying sketch. In the first, or outer, drifts the powder pockets were sunk 4 ft. below the quarry-floor level. In the second drifts the pockets were 2 ft. below the quarry floor, and in the third or last drifts the pockets were at quarry-floor grade.

The quantity and the grade of the several charges are given in the following table. Note that charges 13 to 18 consisted of the quick-acting explosive calculated to move the toe of the slope face first. The 60% powder is simply the priming charge.

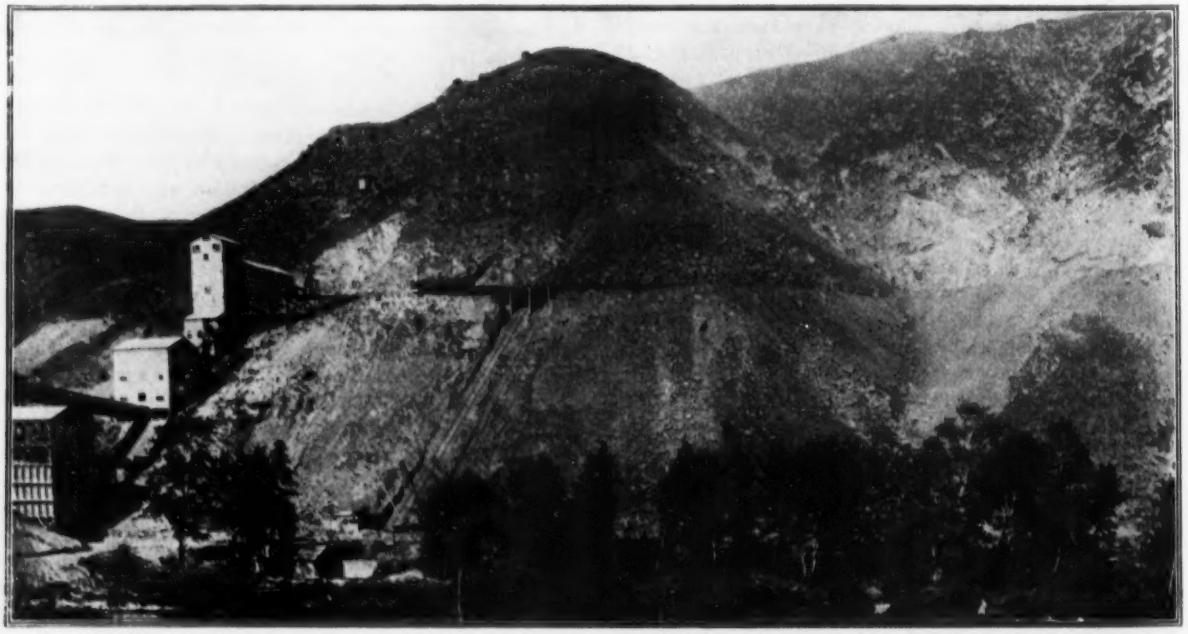
QUANTITY AND GRADE OF BLASTING CHARGES

Load No.	Powder Charges, Tunnel No. 1, Grade and Quantity 60%	40%	25%	Tunnel No. 2, Grade and Quantity 60%	40%	25%
1	50		4,150	50		4,300
2	50		3,650	50		3,850
3	50		3,800	50		3,900
4	50		4,450	50		3,550
5	50		4,050	50		3,300
6	50		4,750	50		4,150
7	50		3,250	50		3,100
8	50		3,100	50		2,900
9	50		3,200	50		2,950
10	50		2,950	50		2,700
11	50		3,100	50		2,800
12	50		3,350	50		3,200
13	50	550		50	900	
14	50	850		50	850	
15	50	800		50	800	
16	50	800		50	750	
17	50	850		50	700	
18	50	950		50	850	
Total	900	4,800	43,800	900	4,850	40,700
Grand Total		95,950 lb.				

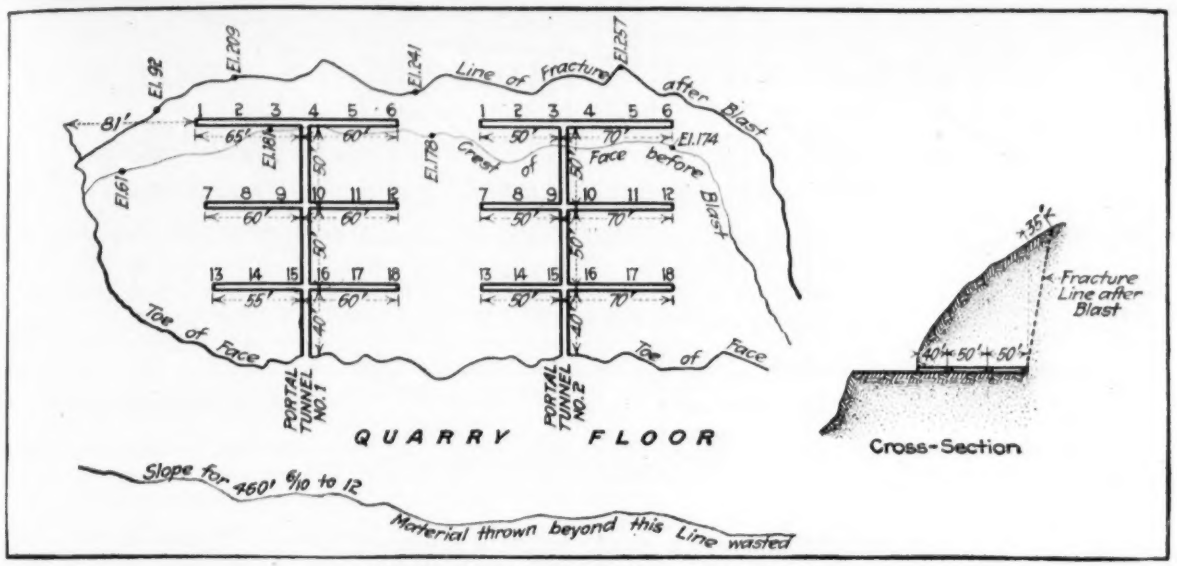
In firing these charges the detonator known as Bickford cordeau, which is chiefly trinitrotoluol, incased in a ¾-in. tube, was used. A single No. 8 cap detonated all the charges simultaneously. This cap was attached to one end of the line of cordeau, which was strung through the tunnels, each branch terminating in a 20-ft. coil embedded in the charge.

Cost 2½c. per Ton

Measurements of the slope after the blast led to the estimate that the 897,000 tons of rock had been shattered by the blast. So effective was the work of the powder that only a slight amount of secondary shooting would be required to prepare the rock for the crusher—probably about one ton of 40% powder for bulldozing each 100,000 tons of rock.



NO ROCK WAS LOST OVER THE EMBANKMENT DUE TO SPECIAL METHODS OF LOADING AND FIRING



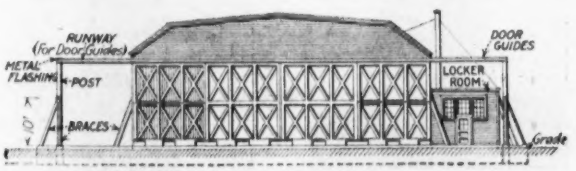
LOCATION OF CHARGES AND QUARRY CRESTS

The cost of driving 1000 ft. of tunnel at $5 per foot was $5000. The cost of the explosive was $14,808, to which was added $96.72 for 1860 ft. of cordeau. Loading, tamping and incidental expenses amounted to $603, so that the total cost of the blast was $20,508, or about 2½c. per ton. The tunnel work and the placing of the charges was done under the direction of J. C. Costello (who supplied the foregoing information) and J. C. Cushing, engineers for the California Trojan Powder Company.

Long Timber Truss Hangar Roofs Have No Knee-Braces

Airplane Sheds in United States Army Camp Require Special Details of Construction and Door Equipment

ROOF trusses of 66-ft. span, with no knee-brace connections to the columns, are used in the hangars or airplane sheds of the Selfridge aviation camp, near Mt. Clemens, Mich. These sheds must have all the clear



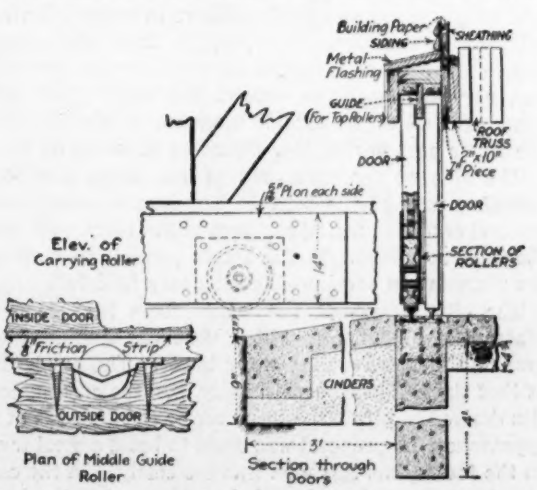
DOORS HAVE OVERHEAD GUIDES

space possible, and knee-braces would have formed obstructions. The necessary lateral stability is given therefore by outside braces against the posts.

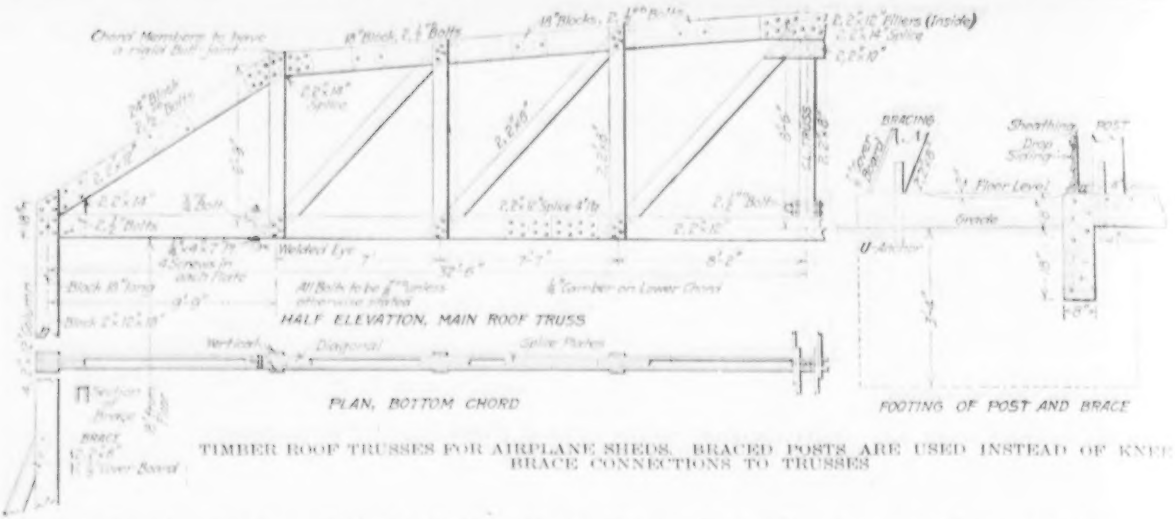
Each post is made up of four 2 x 12-in. planks, the two outer planks being separated 2 in. from the inner ones by means of spacing blocks. The brace consists of two planks 2 x 8 in., having their ends fitted between the planks of the post, and having a ⅞-in. cover board on the outside. The posts rest on the concrete floor of the shed, and the braces on concrete footings, as shown. The posts and trusses are spaced 15 ft. c. to c. The sheds are 66 x 120 ft., widened to 81 ft. at the middle by a lean-to locker-room 15 ft. wide, on one side. There is a 4-in. concrete floor on 4 in. of cinders, and the floor extends 3 ft. beyond the ends.

The roof trusses have all members composed of pairs of planks. The chords and end posts have 2 x 12-in. planks spaced 4 in. apart so that their ends fit between the planks of the posts, as noted above. The web members are pairs of 2 x 8-in. planks, the diagonals fitting between the chord planks while the verticals are on the outside. The parts are put together with ⅞-in. bolts and 40- and 20-penny nails. For slinging the airplanes there are ¾-in. eye-bolts in the bottom chord. Longitudinal struts are spiked against the middle posts of the trusses. Purlins 2 ft. c. to c., composed of pairs of 2 x 8-in. planks, rest on the trusses and carry the roof sheathing.

To facilitate moving the airplanes in and out of the shed, the entire cross-sectional area of the building (be-



LARGE DOORS CARRIED ON GROOVED ROLLERS AND GUIDED BY HORIZONTAL ROLLERS



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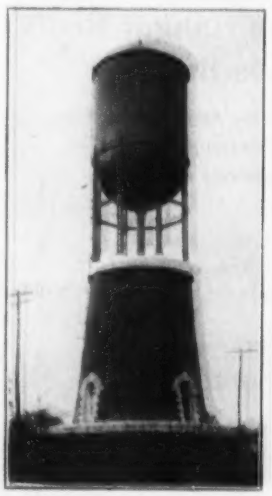

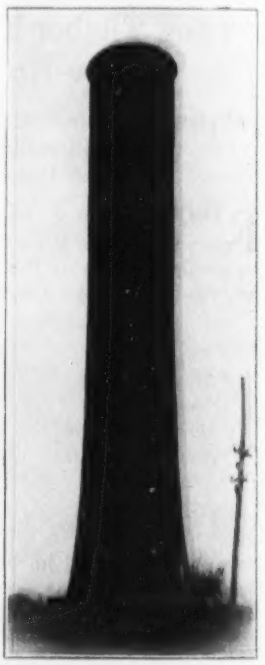

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At the beginning of the work, sand, cement and lime were placed in piles 100 ft. apart along the flume line. It was soon found, however, that by spacing the materials at 50-ft. intervals the capacity of the plant was increased 15%, and this spacing was thereafter used. Materials were delivered to the work by two 5-ton motor trucks operating on the bench ahead of the flume. The use of the bench as a roadway was considered an advantage in helping to pack down the fills.

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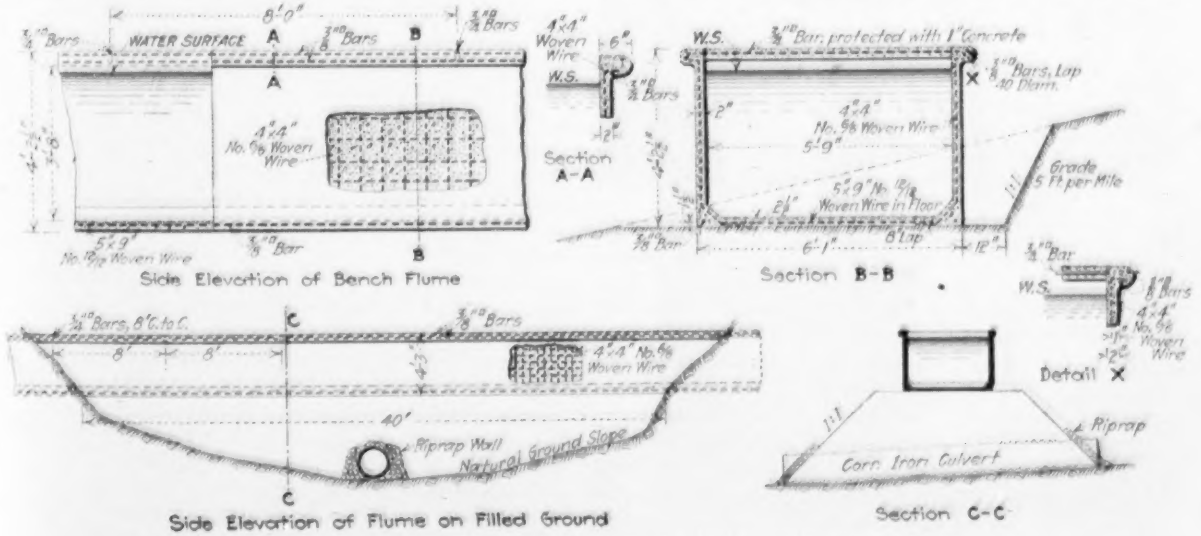

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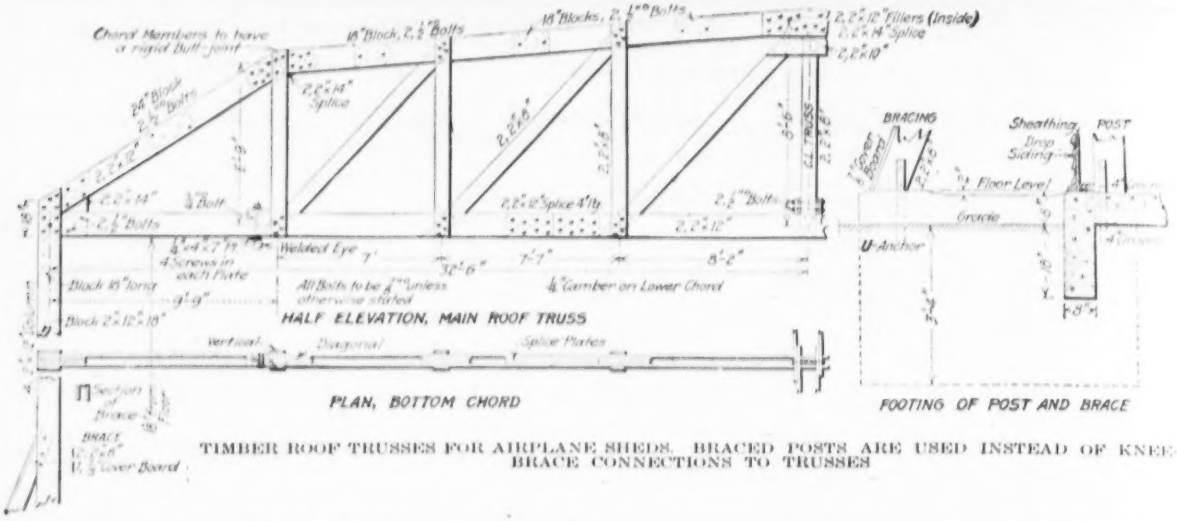

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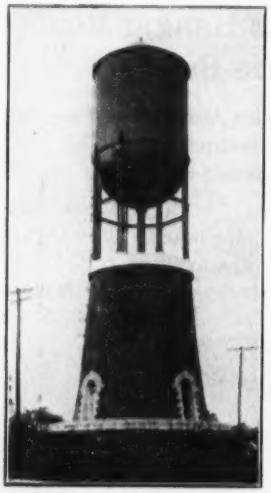

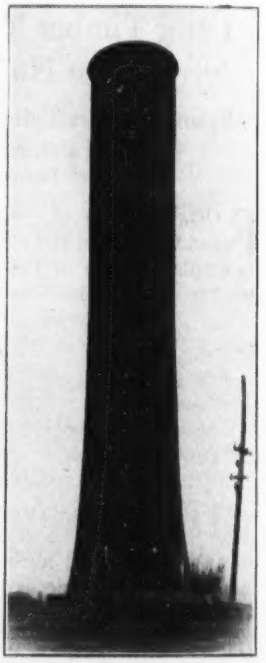

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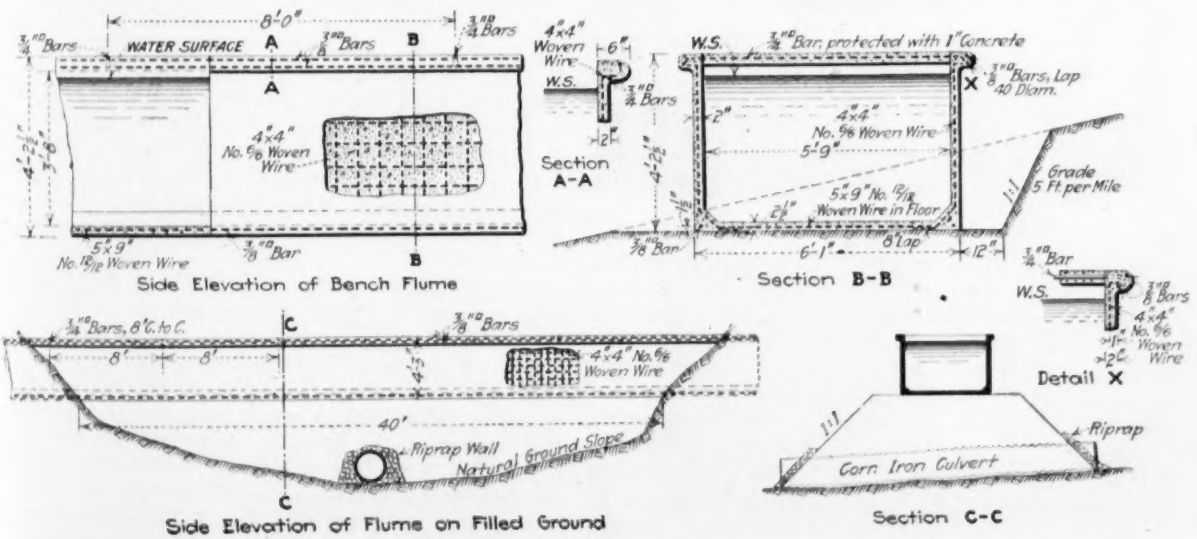


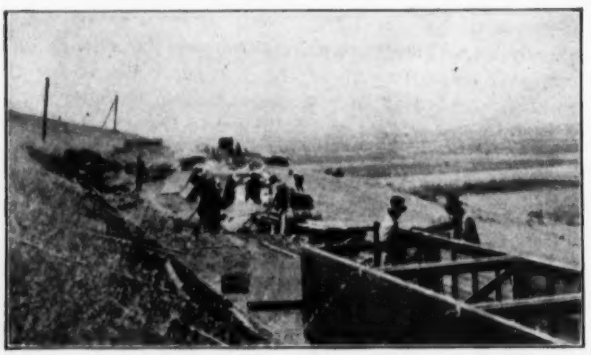
DESIGN BASED ON TESTS OF FULL-SIZED EXPERIMENTAL SECTIONS

ROUTE FOLLOWS A HILLSIDE

was found that the two rubber nozzles, one at the discharge end of the hose and one between the gun and the hose, required replacement after about every 300 cu.yd. of material.

Wood Forms Used Repeatedly

In starting a new section of the work the wood forms for the walls are first set up, and the reinforcing is attached to them. Inside forms only are used and are made up in 8-ft. sections from 1-in. tongue and groove flooring, well studded and braced. A wood block is used



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to keep the forms the required distance above the grades. The forms are kept well oiled and after having built 1½ miles of flume were still in good shape. About 500 lin.ft. of forms are in use, and the cost of repairing these on the first 1½ miles of flume was $28. Six standard curves are used, these being of 25-, 50-, 100-, 150-, 200-, 250-ft. radii respectively. The forms for these curves are made up of light steel plate fastened over a wood framework. In the use of these steel forms it is notable that considerable difficulty was experienced in making the cement adhere to the steel surface, enough to prevent "overhang."

The reinforcement in the walls is placed 1¼ in. from the inner face of the flume. This spacing is maintained by 1½ x ½-in. bars placed between the form and the reinforcing wire, which are removed when the concrete is shot up to this depth. The side walls are shot first and immediately followed by the beam, which is poured by hand into a form clamped to the wall form. Material for this beam is provided by mixing the rebound or wastage from the side walls with 33⅓% of cement. This rebound is caught on canvas previously placed along the bottom of the wall form. The forms are left on 24 hours and, finally, after their removal, the floor slab is shot with the gun.

Finished Flume Kept Full

Near the upper end of the flume, water from wells is pumped into it and allowed to flow down to a bulkhead near the point where work is under way. The flume is bulkheaded at close intervals with a light wooden bulkhead faced with gunite, so that the mortar is kept wet during the setting period and water is always at hand for the gun and for hosing exposed surfaces. Permanent radial breast gates are provided at approximately one-mile intervals, so that after the flume is in operation its contents can be conserved in case of a shutdown. These were not made automatic, as it was not believed that this additional expense was warranted.

On the completion of a section of the flume a bulkhead is placed at the downstream end and a hole cut in the bulkhead of the preceding day's work to admit the water. Previous to this, immediately after the side walls are constructed, burlap is hung over the walls and is sprinkled with a hose during the day time until this section of the flume is completed and the water admitted. With this procedure the curing has been effected without developing any cracks whatever.

To reduce the likelihood of cracks caused by settling, the thickness of the bottom slab is increased to 3 in.

over fills and the reinforcement is here made the same size as that used in the walls. The fills, however, are not over 10 ft. in height and average about 6 ft. They were placed about 8 months ahead of flume construction and before the rainy season was over. Specifications called for wetting and tamping in thin layers. However, on those fills which showed considerable settlement, the flume was supported on three longitudinal beams running down to solid material. Culverts were placed for all watercourses, and cross drains of 6-in. sewer tile were put under the flume at 400-ft. intervals to take care of all drainage from above the bench.

The gun crews work 8 hours per day, the crews usually being made up as follows: One gun operator; 1 nozzleman; 1 nozzleman assistant; 1 compressor operator; 1 laborer shoveling sand, etc.; 2 laborers

CREW PLACED 130 LIN.FT. PER SHIFT

screening; 4 laborers mixing and turning material; 10 laborers finishing grade and wrecking forms; 4 men placing steel; 3 men setting forms.

This crew can place about 130 lin.ft. of flume, or 147 cu.yd., per 8-hour day. The side walls are shot in two layers. The first layer, which comes up to and covers the reinforcement, is 1½ in. thick; and after this has set for 20 min., the final outside layer of ½-in. thickness is applied. In shooting these walls it is found that the rebound which collects on the canvas strips at their base amounts to about 10% of the material which adheres to the forms. In remixing this rebound for use in the longitudinal beams it is considered as inert sand, although doubtless it has a certain per cent. of cement content. The crew which remixes this rebound follows the gun crew immediately, so that there is no time for initial set to have taken place between the two operations.

The flume was designed and constructed under the supervision of Stephen E. Kieffer, M. Am. Soc. C. E., consulting engineer, of San Francisco. The contract for the work is held by James Kennedy, of Los Angeles.

Harlem River Draw Is 389 Ft. Long

The swing bridge of the New York Central Railroad across the Harlem River, which was repaired by the unusual pin bushing method described in our issue of Aug. 9, has a swing span 389 ft. long, instead of 310, as by error marked on the drawing shown on p. 245.

Well Yields Different Water After Being Sealed a Year

Peculiar Phenomenon in Saratoga Springs District—Change from Soda to Salt Water with Burst Upon Pumping

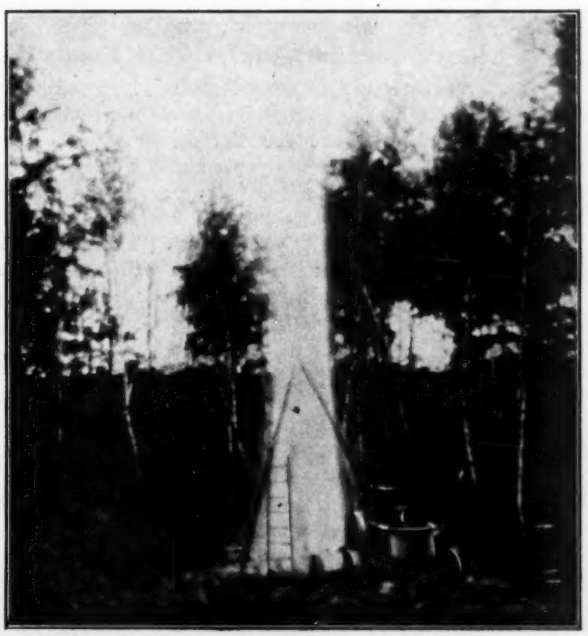
BY CHARLES G. ANTHONY
Chief Engineer, State Reservation, Saratoga Springs, N. Y.

AMONG the many interesting natural phenomena observed in the series of studies in the mineral water basin of Saratoga Springs conducted during the last few years, the following changes in the character of the yield of a deep well within a year after it was drilled may be noted.

In 1914 a 6-in. drill hole was sunk to a depth of 420 ft. at Saratoga Springs for purposes of experiment and observation. The drill passed through a heavy deposit of drift and Hudson River shales and terminated in limestone. The well was dry for 150 ft. Below this depth an abundance of water was found.

As soon as the shales were penetrated, a strong odor of sulphuretted hydrogen gas became apparent. A few hours after the appearance of water in the hole, the water bubbled and effervesced as do all the Saratoga mineral waters. The other springs and wells in this basin show large quantities of CO_2 gas with now and then a trace of sulphuretted hydrogen, while the experimental bore showed large quantities of sulphuretted hydrogen and just a trace of CO_2 gas.

When a vessel was filled with the thick muck brought up by the sand bucket, the mass exhibited a curious behavior, rising and flowing over the edges of the vessel like batter until a large collection of gas that had formed in the interior of the mass came to the surface and passed off into the atmosphere. The contents of the vessel then seemed to collapse and sink to about one-



A SIX-INCH STREAM OF FROTHY WATER SPOUTED TO THE TOPS OF THE NEIGHBORING PINES

half of its original volume. At short intervals this mass would again overflow the vessel until it was practically empty. The chemist found the gases thus given off to be mainly sulphuretted hydrogen with a small admixture of hydro-carbon gases.

After reaching a depth of 420 ft. the well was thoroughly sand bucketed and pumped until a clear, sparkling sample was obtained. The result of an analysis was a complete surprise, for the water had very few of the characteristics of the Saratoga waters. The water was quite devoid of chloride of sodium but carried a very large amount of sodium bicarbonate. All of the other springs show sodium chloride ranging from a minimum of 2091 to a maximum of 10,646 p.p.m., yet not a trace could be found in this water.

The well was pumped to capacity (10 gal. per min.) for a few days, then closed by means of a cap placed at the top of the 6-in. casing.

Analysis Unchanged at First

A year later the well was opened, a deep-well pump installed and by means of rubber seals the well was pumped in successive 20-ft. sections. Yields from 0 to 10 gal. per min. were found, but a complete analysis showed the water to be the same as that analyzed the year before.

On the eighth day after pumping started the well belched forth great quantities of CO_2 gas, the tubing and seals were thrown high in the air and were shortly followed by a 6-in. stream of frothy water that spouted over the tops of the neighboring pine trees. A separator was installed and careful measurement showed a ratio of 120 volumes of gas to 1 volume of water. An analysis of this water showed that the mineralization had doubled and that the water then contained 5707 p.p.m. of sodium chloride and no sodium bicarbonate. The total mineral contents at this time were 10,419 p.p.m., against 6533 a year before.

States Spend $33,087,410 for Roads

Out of a total outlay of $85,099,088 for permanent improvements by the 48 states of the Union within the year, $33,087,410 went for the construction of new roads and the permanent improvement of existing highways. The figures given are from a report on the "Financial Statistics of States, 1916," compiled under the direction of Starke M. Grogan, chief statistician for statistics of states and cities, which will be published by S. L. Rogers, U. S. Bureau of the Census, Washington, D. C. More than half of the road outlays covered by the total given were made in two states, New York having spent $10,742,913 and California $7,706,376. Maryland expended $3,563,697. The circular issued by the Bureau of the Census says further: "Only 21 states—Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Ohio, Michigan, Minnesota, Maryland, Louisiana, Montana, Idaho, New Mexico, Arizona, Utah, Washington, Oregon and California—expended money directly on the construction and improvement of roads during the fiscal year, but a number of the other states apportioned sums to counties, municipalities, etc., which were spent in the construction and improvement of roads."

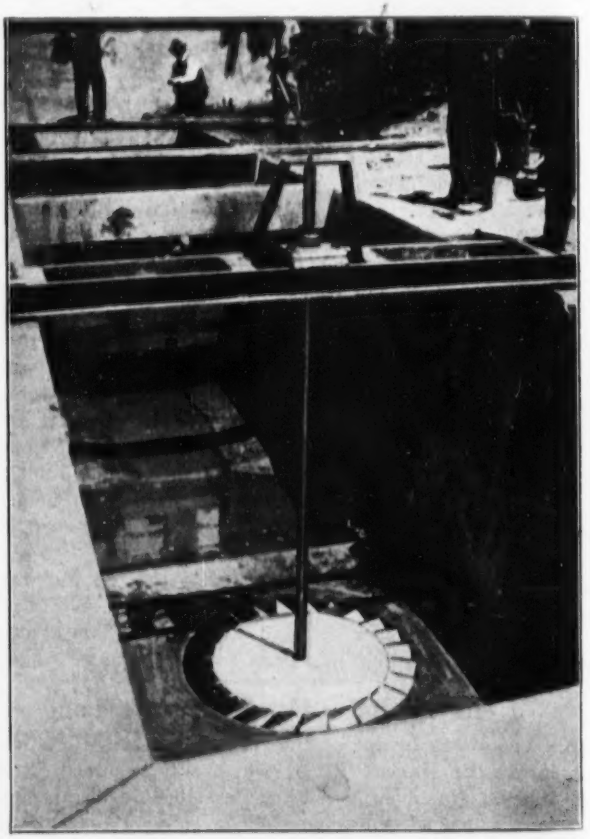
Los Angeles Sets Large Velocity Meter in Open Conduit

Costing $800, It Registers on Less Than One Second-Foot, Showing an Efficiency Greater Than 98 Per Cent.

By J. E. Phillips
Engineering Department, Bureau of Water-Works and Supply, City of Los Angeles

THE NECESSITY for some means of accurately measuring and recording the daily amount of water supplied to the City of Los Angeles, Calif., through the several main trunk lines led to the construction and installation of a large meter at the south portal of Franklin tunnel where the aqueduct supply enters the Upper Franklin reservoir. It was designed by William Mulholland, chief engineer of the Los Angeles City Water Department, and built and installed under the supervision of Fred J. Fischer, chief mechanical engineer.

The meter operates on much the same principle as the so-called velocity-crest meters, its size and the results obtained with it being the main features of interest. It was placed in an uncovered, concrete-lined conduit, at which point the quantity of water at present passing varies from 10 to 50 or more sec.-ft. The value of the meter as a measuring device depended upon whether or not, between the above limits, a constant quantity of water would pass the meter per revolution of the propeller wheels. The results obtained with the one in-



METER IN PLACE BEFORE WATER TURNED THROUGH

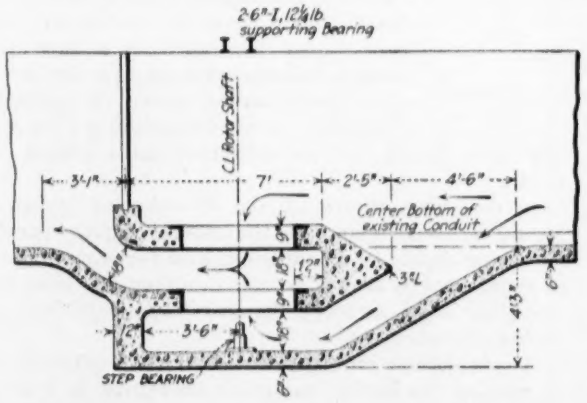
stalled have been so gratifying that the department has two more now under construction and several additional ones contemplated.

The meter is very simple in construction. It consists essentially of two horizontal propeller wheels, 4 ft. in diameter, fastened 18 in. apart to a 2-in. diameter vertical steel shaft supported at top and bottom by thrust and lateral ball bearings to minimize friction. A concrete housing for the wheels is constructed in such a manner as to divide the water which enters the meter —one part passing downward through the upper wheel and the other part passing upward through the lower wheel. The discharge is through a lateral opening between the wheels. A meter register attached to the upper end of the shaft records the water passed.

The propeller wheels are built of galvanized sheet metal in the form of hollow drums, with cast-iron hubs. These drums are 3 ft. in diameter and 9 in. thick. To the circumference of each drum there are fastened 24 galvanized sheet-metal propeller blades by means of 1½-in. angles. These blades are given a pitch of about 40°. The drums were made water-tight by soldering the joints, the size given being such that the weight of water displaced is about equal to the weight of the wheels and shaft. The cast-iron step bearing and the lower end of the steel shaft are fitted with bronze plugs between which a 2-in. diameter agate ball operates to take the thrust. Roller steel collar and thrust bearings are used at the top support, which consists of two 6-in. I-beams laid transversely to the conduit.

The meter was rated by means of a 5-ft. weir placed in the conduit downstream from the meter. The head on the weir was read by means of a hook gage, provided with a vernier reading to thousandths of a foot. Two observers with stop watches noted the time for 10 revolutions of the meter while a third observer read the hook gage, both at the beginning and the end of the count, the mean of the two gage readings being used in case the two readings varied. About 80 observations were taken, covering a range of flow of water from 0 to 38.5 sec.-ft. The meter began to revolve when the weir showed a flow of 0.06 sec.-ft.

The results of the observations when platted on cross-section paper showed a straight line, the average quantity of water passing the meter per revolution being 84



THE METER IS SET IN A CONCRETE HOUSING

Water passes down through the upper wheel and up through the lower wheel, neither of which is shown, and is discharged laterally between the two wheels

THE TWO METER WHEELS ASSEMBLED IN THE SHOP

cu.ft. None of the readings varied more than 2% from the average. The larger of these variations were due to inaccuracies in the reading of the hook gage, as surges occurred at times in the weir approach, making accurate reading impossible. The loss of head in the meter for 38½ sec.-ft. was 1.25 ft. This loss can be decreased somewhat by increasing the size of opening between the propeller blades and by spacing the wheels farther apart.

The cost of the meter installed was about $800. A considerable portion of this cost was due to the construction of a temporary bypass for handling the water during installation of the meter.

Finishing Concrete Roads with a Roller

New specifications for concrete roads in Florida contain the following paragraph on surface finishing:

"The surface of the concrete shall be struck off for the entire width of the pavement, and from back to back of integral curbs when used by means of a template or strike board. Any holes left by removing any materials or device used in constructing the joint shall be filled immediately with concrete from the latest batch deposited. The concrete for a distance of 18 in. out from the curb line shall be finished with a steel trowel. After the concrete has been brought to a true surface, it is to be immediately rolled with a light steel roller made of ¼-in. sheet steel, the roller to be 8 in. in diameter, 5 to 8 ft. long; a number of these rollers to be provided—some longer, some shorter. They shall be attached to a long pole so that all portions of the surface of the pavement may be rolled without the necessity for the workman to step upon the finished work. The rolling shall continue until free water ceases to flush to the surface. The roller shall be so manipulated as to carry the free water from the finished portions of the work onto the unfinished portions. After rolling the surface is to be finished by dragging a canvas belt or by other means satisfactory to the engineer so as to produce an even-texture surface and one which is rough to the touch. When finished the surface of the pavement shall be free from depressions of any quality or any kind and shall not vary within 3 ft. more than ¼ in. from the specified contour."

Diagrams Facilitate the Design of Concrete Forms

After Systematic Study of Conditions the Sizes of Members May Be Readily Traced from Standardized Curves

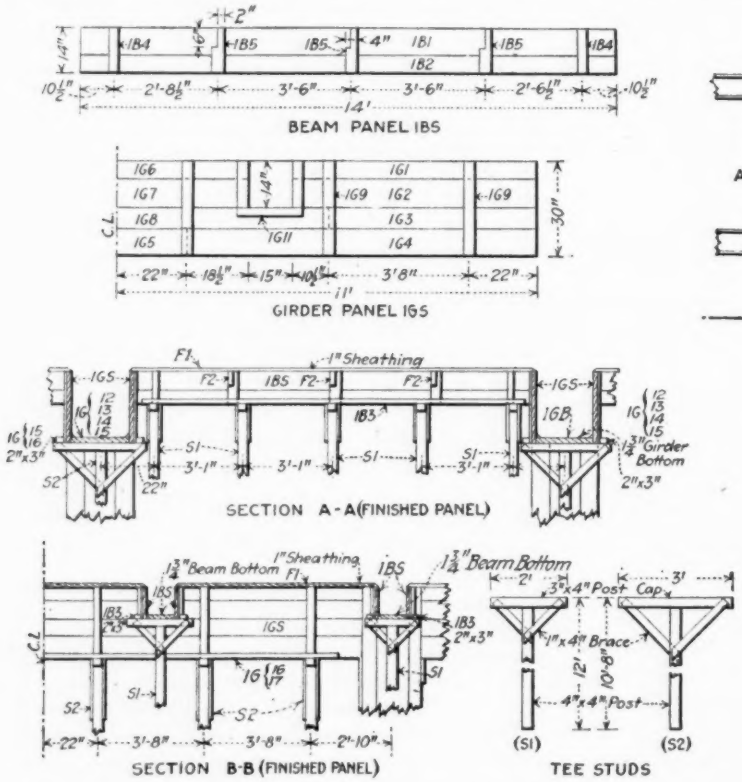
By A. Norman Laird
Instructor in Civil Engineering, Toledo University, Toledo, Ohio

FOR THE PURPOSE of readily designing wooden forms for concrete work, the writer has prepared a set of curves which can be simply applied to formwork for floor slabs, beams, girders, columns and walls, laid out according to the general details shown in Fig. 1.

The curves which are shown in Figs. 2 to 6 are divided into three sections—Figs. 2 and 3 for the design of sheathing, Figs. 4 and 5 for the design of beams, and Fig. 6 for the design of struts. In using the table for beams and sheathing, the procedure is identical; that is, a unit stress for the timber is assumed, and entering the diagram at the lower right-hand corner, the proper size of the form member is found by following vertically to the proper head of the concrete and then horizontally to the proper timber size for a given span or depth.

The curves take into account the semi-continuity of the sheathing. Since formwork is temporary, it will safely bear higher loads without excessive deflection of the permanent member similarly loaded. For such members as slabs, beams and girders, the usual safe timber unit stresses should be assumed, but for columns, walls, etc., where no construction loads will materially increase the total, a unit stress 50% higher than the normal working timber stress should be used, limited by a maximum value of 1200 lb. per sq.in. The weight of the concrete has been assumed as 150 lb. per cu.ft., and the excess over what the concrete probably will weigh will take care of the load of the sheathing and the supporting joists. If a definite heavy concentrated load is to be placed on the formwork during construction, it must be taken care of by computing the bending moment and then referring to Fig. 4 for the proper size and member.

The head of concrete to be used in the curves is the actual depth of the member, limited however by the depth to be poured in one hour. In the design of column forms, using the full depth of concrete, there is a slight error on the side of safety because the loading on the sheathing is not uniform between supports. This, however, is small and may be neglected. In the cases of walls this error will not enter, provided the entire depth is not poured in one hour. This is because the point of maximum pressure will move higher as the pouring is continued, and it will tend to approach uniform loading.



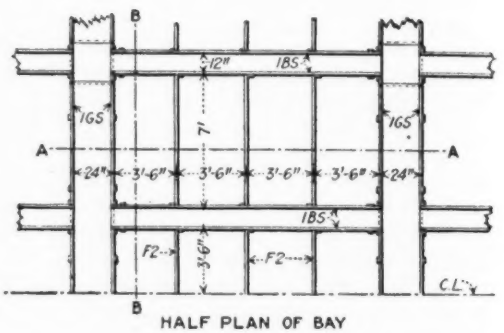


FIG. 1. TYPICAL LAYOUT OF FORMS FOR WHICH DESIGN CURVES ARE MADE

Deflection Should Be Considered

After determining sizes from the diagram, the maximum allowable deflection (usually considered $\frac{1}{4}$ in.) should be taken into account in the design. In case a span determined for a given case exceeds the allowable span for the maximum deflection as shown in Table II herewith, the deflection will govern and the span found in the deflection table should be used.

In designing sheathing, the direction of laying it should be considered. In the case of narrow panels, sheathing should be placed lengthwise for economy, and in square panels it may be run in either direction. In any other panel, however, the sheathing should be tried in both directions.

A considerable difference in materials is often found in cutting the lumber to better advantage in a more economical arrangement of supporting joists and studs. Joists should be designed for a load of $P_1 = 150\ hs$, where h is the head of concrete and s_1 is the span of the

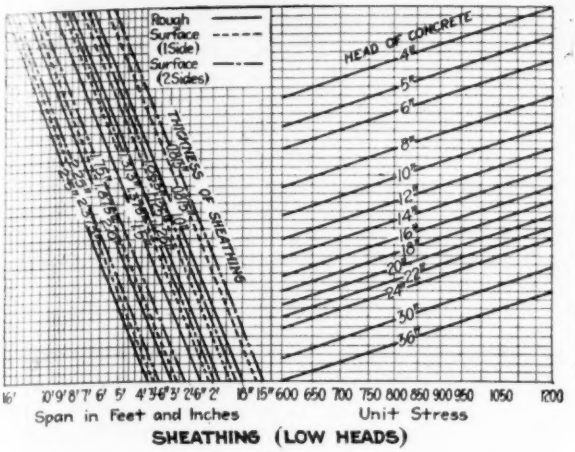


Fig. 2

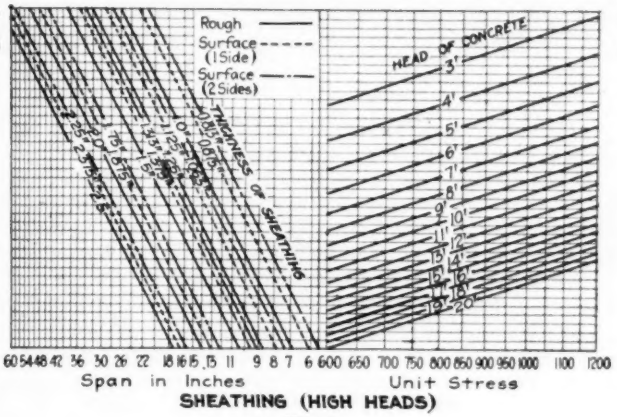


Fig. 3

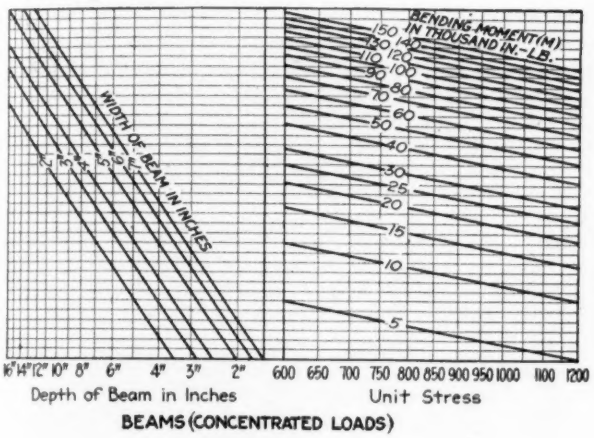


Fig. 4

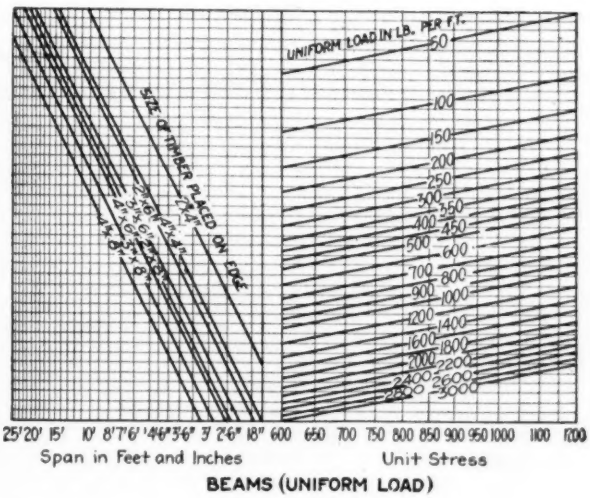


Fig. 5

DIAGRAMS TO BE USED IN DESIGNING BEAMS AND SHEATHING

sheathing in feet. Sizes of joists and the span length s, can be taken from either Fig. 4 or Fig. 5. In some cases it may be found economical to support the joist on beams. The span length must be assumed and the bending moment determined. The size required will then be found in Fig. 4.

In finally tabulating the design, the board measure should be recorded for each step, using commercial

TABLE I. BOARD MEASURE PER LINEAR FOOT

Thick. in In.	Width in In. 1	1¼	1½	2	3	4	6	8	10	12
1	0.083	0.1	0.125	0.167	0.25	0.33	0.5	0.667	0.833	1.0
1¼	0.1	0.12	1.156	0.208	0.313	0.417	0.625	0.833	1.043	1.25
1½	0.125	0.156	0.188	0.25	0.375	0.5	0.75	1.0	1.25	1.5
2	0.167	0.208	0.25	0.33	0.5	0.667	1.0	1.333	1.667	2.0
3	0.25	0.313	0.375	0.5	0.75	1.0	1.5	2.0	2.5	3.0
4	0.33	0.417	0.5	0.667	1.0	1.333	2.0	2.667	3.333	4.0
6	0.5	0.625	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0
8	0.667	0.833	1.0	1.33	2.0	2.667	4.0	5.33	6.667	8.0
10	0.833	1.04	1.25	1.667	2.5	3.333	5.0	6.667	8.333	10.0

TABLE II. PRACTICAL ALLOWABLE SPAN IN FEET AND INCHES FOR DEFLECTION = 0.25 INCHES—STRESS IN POUNDS PER SQUARE INCH

Thick. in. In.	600 Ft.	600 In.	700 Ft.	700 In.	800 Ft.	800 In.	900 Ft.	900 In.	1000 Ft.	1000 In.	1100 Ft.	1100 In.	1200 Ft.	1200 In.
1	4	10	4	7	4	3	4	0	3	10	3	8	3	6
1.25	5	6	5	1	4	9	4	6	4	3	4	0	3	10
1.5	6	0	5	7	5	2	4	11	4	8	4	4	4	3
1.75	6	6	6	0	5	7	5	4	5	1	4	8	4	7
2	6	11	6	5	6	0	5	8	5	4	5	1	4	11
2.5	7	9	7	2	6	8	6	4	6	0	5	8	5	6
3	8	6	7	10	7	4	6	11	6	7	6	3	6	0
4	9	10	9	1	8	6	8	0	7	7	7	3	6	11
6	12	0	11	1	10	5	9	10	9	4	8	10	8	6
8	13	10	12	10	12	0	11	4	10	9	10	3	9	10
10	15	6	14	4	13	5	12	8	12	0	11	5	11	0

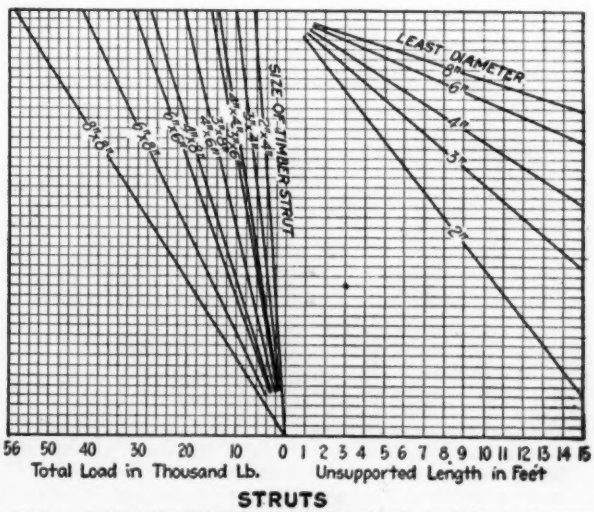


FIG. 6. TAKE STRUT DIMENSIONS FROM THESE CURVES

lengths as indicated in Table I. The final choice of sizes to be used should be made by a man familiar with the construction work after the above results are tabulated. After making a sketch layout of the type of forms the tabulation made during a design should be referred to and the exact length worked out in detail. Care should be used in selecting the width of boards for panels, etc., to avoid ripping and other special cutting.

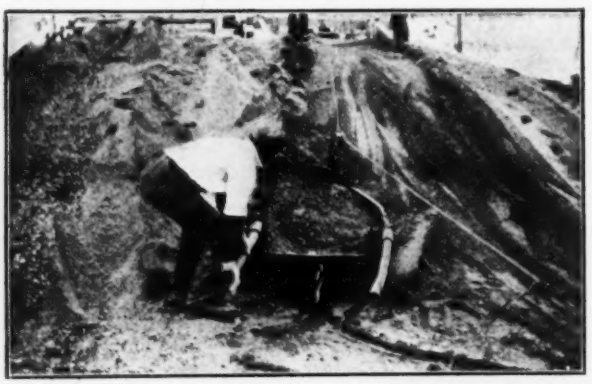
A series of drawings should be made, similar to those shown in Fig. 1, including the assembly, panel details and lumber schedule. Some system of numbering which will indicate where each piece of material in the schedule belongs should be used. The construction work can then be divided into three parts: Cutting lumber, building panels, and the erecting, each of which should be carried on by a separate group of workmen. It is, of course, apparent that companies engaged in a large amount of concrete work will be able to standardize their formwork, and may, therefore, dispense with a considerable amount of the detail designing shown to be necessary.

Apportion Concrete Mixture on Road Job at Loading Hoppers

Motor Trucks Make 7 Miles per Hour—Three Hopper Industrial Cars Connect Storage with Mixer

INDUSTRIAL cars, each carrying three hopper bodies and filled with gravel and cement at a loading station built in the street, form a new equipment for handling road material. They were used on the Kensington Road concrete pavement in Grosse Point, a village immediately east of Detroit. As the contractor's equipment consisted of a ½-yd. cube mixer with caterpillar traction and boom discharge, the use of the ordinary 1-yd. side-dump cars was not feasible. He made up in his shop, therefore, three bodies as shown in one of the photographs. The uncertainty of getting cement and material regularly and the desire not to haul over the sub-base, led to the concentration of the material at one end of the section of pavement, which is 3400 ft. long.

The layout at the loading station consisted of two elevated cement hoppers, one over each track. Back of one was a hopper for the sand and gravel, which is pit-run screened, and back of the other was a hopper for crushed granite. Cement was stored under tarpaulins and in a small shed on an adjacent vacant lot, and was hauled by barrow up an incline to the hoppers. Bulk cement was used at first, but the irregularity in getting gravel made storage of cement essential. This could not well be provided for on such a small job, so bagged material was used for all but the carloads.



A 3½-TON MOTOR TRUCK AND A SLIP SCRAPER ON AN ENDLESS CABLE KEEP BINS FULL

INDIVIDUAL BATCHES ALL MADE UP EXPEDITE MIXER CHARGING

Leading to the end of the material bins is an incline, up which the gravel and stone are pulled by an ordinary slip scraper attached to an endless cable operated by a two-drum Mundy hoist. These bins have three slide gates so that the three bodies of a car can be loaded at one time. The cars are then pulled forward and receive a measured amount of cement.

Material was hauled about 3½ miles from a wharf where it is loaded either from bins or by clamshell buckets directly into 5-ton trucks. Three trucks were

just able to keep the outfit going. The contractor rented two machines, a Federal and a G. M. C., and kept his own Packard on the same work, except for odd jobs which averaged at least one day per week. The trucks made from 50 to 75 miles per day, averaging about one round trip of 8 miles per hour. The bodies held 135 cu.ft. level, but only 4 cu.yd. was loaded.

PROGRESS OF MIXER CREW

Progress made by the mixer crew of 14 to 16 men averaged eight slabs 30 ft. long and 25 ft. between curbs. The pavement is a 5-in. two-course, reinforced-concrete slab with a 2-in. finish of rich mix with granite aggregate. A move was made for every 15 ft. of the lower course, the loop of the industrial track—super-elevated—being pulled back so that the outside rail was 18 in. from the charging skip when the latter was let down. One horse was kept handy to pull the cars around the curve and three more to haul the cars. At the material bins were 15 men distributed as follows: 1 engineman at hoist; 1 handling slip; 2 tending gravel bins; 2 opening cement bags; 5 loading and handling cars below; 2 hauling cement; 1 cleaning and bundling bags, and 1 foreman.

Clarence Raymond was superintendent for R. D. Baker, the contractor, until transferred to another job, when R. H. Baker took his place.

London Tips More Than Half Its Refuse

Greater London disposes of 58% of its mixed garbage and refuse by tipping or dumping and only 42% by destructors, according to a recent paper presented by Reginald Brown before the Institution of Municipal and County Engineers. Inner London has 62% of its refuse removed out of the district by rail or barges, carts 3% to dumps and sends only 35% to destructors. Outer London dumps 46% within its own area, ships 1% away by barge and rail and sends 53% to destructors.

Concreting Plant Has Novel Way of Handling Cement

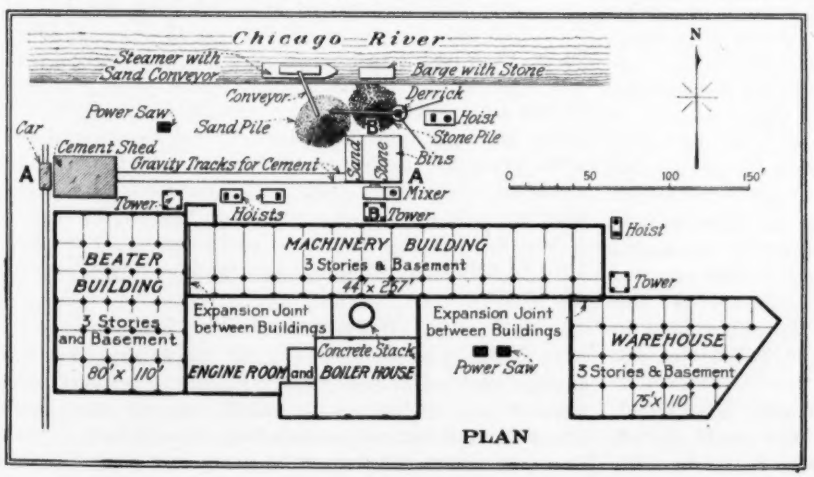
Cement Delivered from Shed to Mixer by Gravity Tramway—Sand and Stone Unloaded from River to Same Mixer

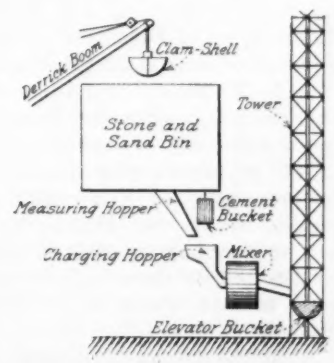
BY W. STUART TAIT
Vice President and Chief Engineer, Concrete-Steel Products Co., Chicago

INTERESTING methods of handling materials are employed in the construction plant of the paper mill of the Chicago Mill and Lumber Co. at Chicago. The plant is adjacent to the north branch of the Chicago River. It was found that crushed stone and torpedo sand could be delivered most economically by means of barges on the river, while on the other hand, the cement could be more economically delivered by rail. The accompanying view and plan show the general arrangement adopted for the concreting plant.

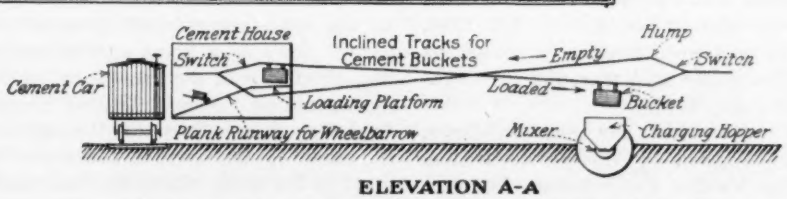
The crushed stone was brought to the site in barges having a capacity of 185 cu.yd. and was unloaded from these by means of a stiffleg derrick with 1-yd. clamshell bucket. This derrick unloaded the stone directly into the elevated stone bin or into the reserve pile. The torpedo sand was unloaded from the hopper dredge or sand-sucker by means of an inclined "Hydro" belt conveyor on a boom forming part of the equipment of the boat. The conveyor could deliver the sand about 30 ft. from the side of the boat and at an elevation of about 30 ft. above the ground. The derrick and clamshell bucket noted above picked up the sand from this point and placed it in the sand bin.

On account of the layout of railway tracks adjacent to the building, the cement shed had to be at the northwest corner of the building, as shown. The cement car was set alongside this shed and there unloaded. Two inclined tracks, one for delivering this cement in buckets



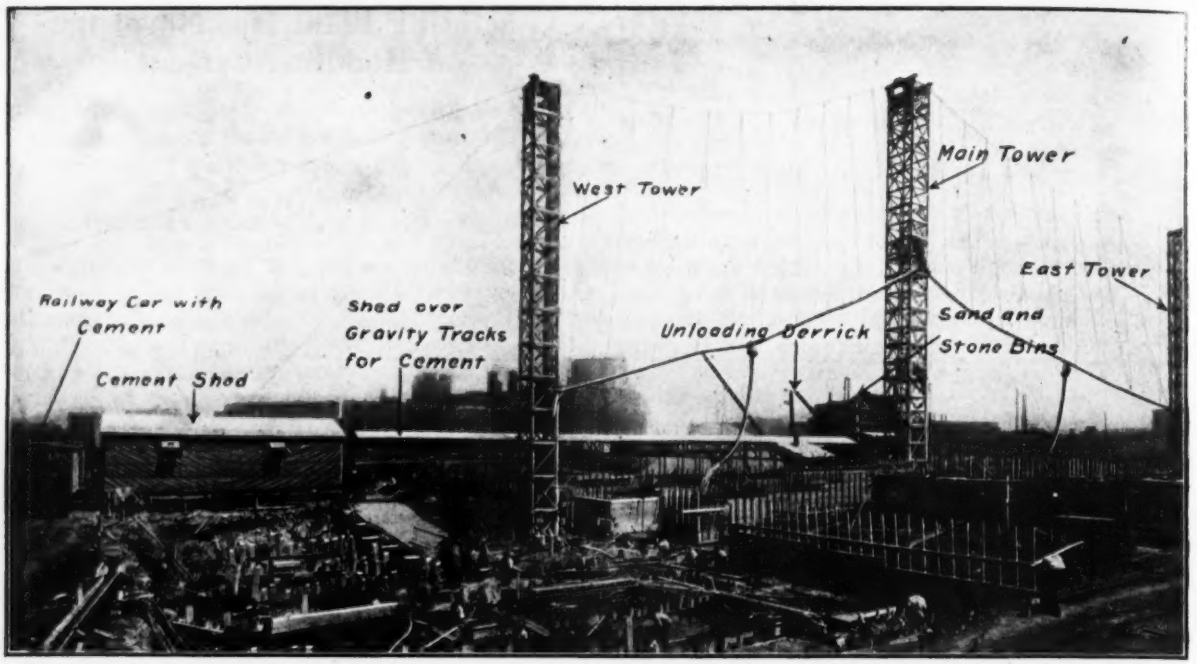


ELEVATION B-B



ELEVATION A-A

CEMENT COMES IN BY TRAIN, SAND AND STONE BY RIVER



CONCRETING PLANT FOR LARGE PAPER MILL IN CHICAGO

from the storehouse to the charging hopper, and the other for returning the empty cement bucket, were installed between the cement house and the concrete mixer. These are shown in the drawing of the layout of the plant.

The filled cement bucket traveled by gravity from the cement house to the charging hopper of the mixer, and a lever controlling the bottom of this car dumped the six-bag load directly into the hopper. The empty car was then pushed over a switch and hump to the return track and transferred back to the cement house by gravity. This novel arrangement worked in a very satisfactory manner. The track consisted of the ordinary type of barn-door track with the cement car hung from a trolley traveling upon this.

A ¾-yd. Marsh-Capron mixer was used, and discharged into a Lakewood bucket. This bucket carried the concrete up the main tower to a maximum height of 185 ft., discharging into a bucket provided with a two-way gate for distributing the concrete to spouts leading to the two subsidiary towers. The concrete was all placed by spouting directly into the forms. The smaller towers were built to carry the chutes and to serve as cage towers in which lumber, brick, etc., are hoisted.

With the layout illustrated, a capacity of 400 yd. of concrete per day of eight hours was easily placed. The building work proper was completed in five months. Construction work was started about July 15, 1916, and the concrete structures were practically completed by Dec. 15, 1916. The paper mill was put in operation in the middle of June, 1917.

Louis Guenzel was the architect for these buildings. The structures were designed by the Concrete-Steel Products Co., and the Mueller Construction Co. executed the construction work.

Favors Continuing Iowa Road Improvement Policy

T. H. MacDonald Says County Boards Should Plan for Future—Traffic Count Shows Heavy Town-to-Town Travel

A PROGRAM of draining, grading and permanently bridging the public roads has been followed consistently by the State of Iowa since 1913. The effects of war conditions and high prices have not been felt to any extent as yet, and the work done in 1917 is not likely to be much less than that of 1916. It has been pointed out recently by Thomas H. MacDonald, chief engineer of the Iowa State Highway Commission, that the full force of the present situation will not be encountered until plans are made for next year and attempts are made to carry these plans into execution. He urges that the state's policy is correct, and that county boards should take steps to insure its continuance. It remains then to determine how this can be done under present conditions.

Road Work Should Not Halt

It is highly important, says Mr. MacDonald, that the present element of uncertainty should be removed. At present few of the county boards can say that their plans for the future are definitely formulated, or that they can confidently expect to carry out plans looking to the road-improvement program for the next few years. Iowa as a great agricultural state will play an important part in the present national and international food situation. Nearly 85% of its area is now raising foodstuffs that will require transportation over the public roads to the market centers. Therefore, now, if ever, is the time when the roads and bridges need to be in first-class condition. The state does not need

many military roads. But it does need a system of roads radiating from the market centers and kept continuously in condition to carry the traffic of each county.

As a result of the response to the call for increased food production, the roads are being used to a greater extent than ever before. This is shown by a traffic census. An analysis of the situation, therefore, will eliminate all doubt as to the desirability of continuing the program for road and bridge improvement throughout the state.

Progress at End of 1916

At the end of 1916 there were 7330 miles, or approximately 50%, of the county-road systems, built to a natural grade. This represents mainly the work accomplished by tractors and road graders in shaping the roads to standard cross-section, but without any considerable grade reduction. In addition, 1506 miles had been built to permanent grades and standard cross-section, and 535 miles had been surfaced with one-course gravel 10 ft. wide. This is the minimum surfacing specified by the commission, and requires 880 cu.ft. of gravel per mile.

While Iowa has a comparatively small mileage of surfaced roads, its graded and drained earth roads form a foundation for future surfacing and in the meantime provide for present traffic. Gravel surfacing makes the main traveled highways easier to maintain, prevents deterioration of the permanent grades and gives better service to the public. Mr. MacDonald considers that the proportion of funds expended on such surfacing might well be increased.

This Year's Work Similar

The work for 1917 is approximately the same as that for the previous year. During 1916 there were 625 miles of earth roads built to permanent grades and standard section, 107 miles built to temporary grades, 3680 miles built to natural grades, and 277 miles surfaced. In the expenditure of the county-road funds, 40% was for permanent work, 16.5% for temporary work, 16.6% for repairs, 11.9% for maintenance, 7.4% for equipment and unused material and 76% for miscellaneous work.

Of the expenditure for bridges and culverts, 59.3% was for permanent structures, 18.1% for temporary structures, 15.1% for repairs and 7.5% for miscellaneous work. For three years the amount spent for permanent structures has been about 60% of the total.

The continuance of this policy will result, he says, in a gradual reduction of the bridge taxes. In one county this tax has been reduced from 5 mills to 3½ mills, and still there are ample funds for building permanent structures where bridges must be renewed. Even under the adverse conditions of prices for material and labor, permanent construction is the most economical. These conditions, therefore, do not justify spending a larger proportion of the bridge funds on temporary forms of construction.

Concrete pipe for culverts has given good results. Mr. MacDonald states that on the basis of the experience of two counties which have their own pipe-making plants, the reinforced-concrete pipe manufactured by the counties is the cheapest form of culvert pipe now available. He points out that it would be practicable for two or more counties to combine in the manufacture of such pipe while the price of other materials is so high.

Road Traffic Is Weighed and Counted

In a recent traffic census, the usual count of the number of vehicles has been supplemented by taking the weight of the vehicles and thus arriving at the actual tonnage carried. At a point of 2 miles south of Ames (population 5000) road scales were placed and the traffic was weighed for a period of 10 days. The total number of vehicles was 1995, with a total weight of 4,919,468 lb., or a daily average of 200 vehicles and 250 tons. The number of people was 5560, or 556 per day. For each of eight other points the daily average was 387 vehicles and 1259 persons daily, and the weight was estimated at 500 tons.

The surprising feature of the census was the number of persons using the roads. On the road between Mason City and Clear Lake the count for one week showed more than 25,000 people, although the combined population is only 22,000.

Complaint is made occasionally as to the improvement of roads for tourist travel on the theory that the traffic is detrimental to the roads and that the tourists do not contribute to the cost of road improvement and maintenance. To obtain information on this point, particular care was taken to count the tourist traffic. Out of 22,000 vehicles counted at eight points, only 669 (or about 3%) were strictly tourist vehicles, although the stations included some of the best-known routes.

On the other hand, the census shows very clearly that it is the people of each community in the state who are making the most use of the roads. This is still another proof of the need for improved roads, and the desirability of continuing the program for obtaining such roads. The large amount of town-to-town traffic indicates, in Mr. MacDonald's opinion, the necessity for a readjustment in the method of levying taxes for county highway improvement, so that city and town property will bear a larger proportion of the cost.

Co-operation to Secure Low Prices for Material

One of the most important features of Mr. MacDonald's paper is the suggestion that the solution of the problem of supply and price of material can best be met by definite coöperation between the county boards of the several counties. If each county continues to act separately in purchasing material, as under the old plan, prices are likely to range so high as to be prohibitive. Even if orders are placed there will be serious delays in delivery. Contracts placed in this way several months ago are still unfilled.

The suggestion was for the appointment of a committee of the State Association of County Supervisors to collect at once from the county boards their estimates of materials needed for 1918. These will be grouped and bids invited for the total amounts. The committee will have no power to place orders, but will submit the bids to the county boards, leaving the latter to take individual action. This suggestion has been adopted by the association, and its committee will consist of one supervisor from each congressional district. This is the first step, and Mr. MacDonald thinks it will be of interest to see how the plan works.

Large Water-Supply Well Sunk by Open Caisson Method

Open Excavation Inside Five Successive Concrete Rings for Paper Mill Well 45 Ft. Deep and 25 Ft. Diameter

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An order to secure an adequate water-supply for the Scioto Mill of the Mead-Pulp and Paper Co., at Chillicothe, Ohio, a new well was sunk last year by open excavation inside concrete cylinders, which were built above ground and lowered by their own weight.

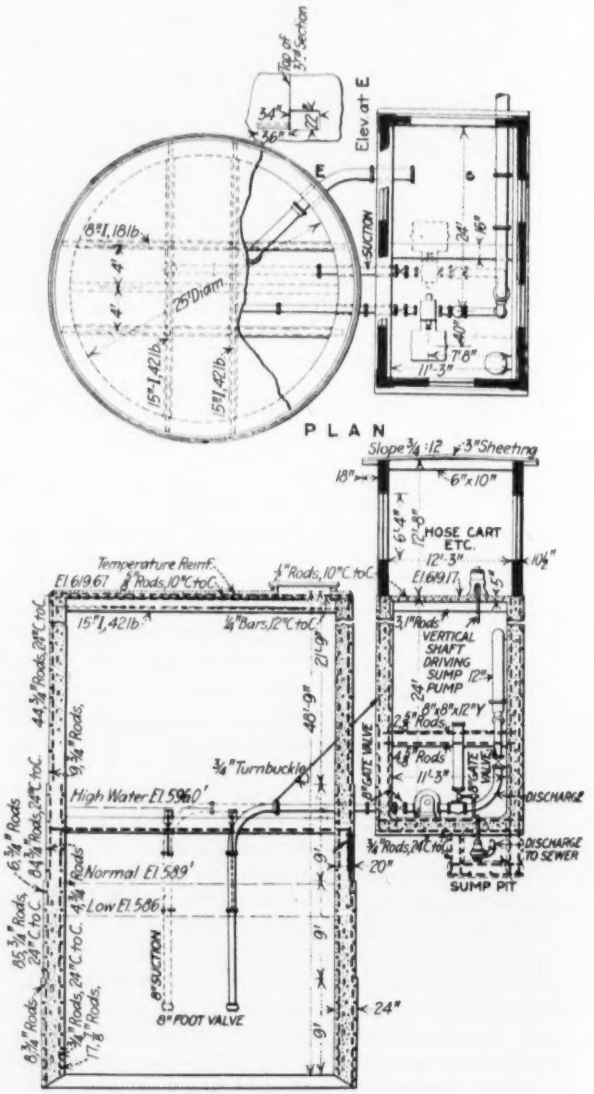
The design provided for five rings, 25 ft. in interior diameter and 9 ft. in depth. The bottom one was 24 in. thick and the next two 22 in. and 20 in. respectively, while the upper two were 18 in. This decrease in thickness was provided to ease the earth friction as the shell went down. Later, a sixth ring 18 in. thick and 3 ft. 9 in. deep was added at the top to bring the top slab flush with the ground.

Excavation was carried to a depth of 10 ft. before setting up the forms, which consisted of 13 segments inside and out, of ¾-in. tongue-and-groove lumber, each backed by six horizontal 2 x 10-in. ribs. A knife edge was formed at the bottom of the lowest concrete ring at an angle of 30° with the horizontal, but on account of the anticipated softness of the soil, a metal shoe was dispensed with. The outer and inner form shells were held together by 4 x 4-in. uprights, bolted together, the bolts passing through 1½-in. pipe spreaders, which were left embedded in the concrete to allow a free flow of the water into the well. The vertical reinforcement in the three bottom rings consisted of two rows of ¾-in. Kahn rib bars spaced 24 in. apart, staggered, and in the top rings, of one row of the same. The horizontal reinforcement in the lower three rings consisted of two rows of steel, the outer being ¾-in. rib bars and the inner ⅝-in., bent to the diameters shown in the drawing. In the upper rings there was but one row of circular reinforcement.

First Ring Sunk in Four Days

Sinking the first ring was started 15 days after the beginning of excavation and was completed in four days. Material was removed from under the ring by hand and thrown to the center, whence it was removed by a ¾-yd. clamshell bucket. The derrick was set so as to control sidetrack, but owing to the inability of the railroad to furnish cars, a hopper was built into which the bucket dumped the material and from which it was hauled by wagons. The material encountered was fine gravel and the work progressed with no difficulty whatever. When the ring had been sunk 10 ft., as shown in one of the views, the forms were placed again. The radius of the outer form was reduced 2 in. by removing sixteen ¾-in. strips from the vertical edges of the segments, enough of these having been previously placed to permit the entire reduction of outer diameter called for in the design. The outer form was moved in 2 in. and rested upon the concrete, while the inner was flush with the old surface and suspended from the outer by the bolts and pipe spreaders heretofore described. The concrete for the second ring was placed the day after the sinking of the first ring. Removal of the form was considerably facilitated by leaving the inner shell tied together and lifting it bodily out by the derrick.

Water was struck at 23 ft., during the sinking of the second ring, which progressed without further incident. The weight of the two rings, estimated to be 242 tons, forced the gravel, without further spading, to the center, whence it was removed by the bucket. The shell slipped down easily, about 6 in. at a time. During the entire job a record of the movement was kept, levels being taken at four fixed points and these plotted in a notebook. This chart showed the foreman instantly which point was highest and directed his efforts to that side. Three ¾-in. jets with flexible connections were used to expedite the sinking of any side that might be lagging. The sinking of the first two rings required about four days each.

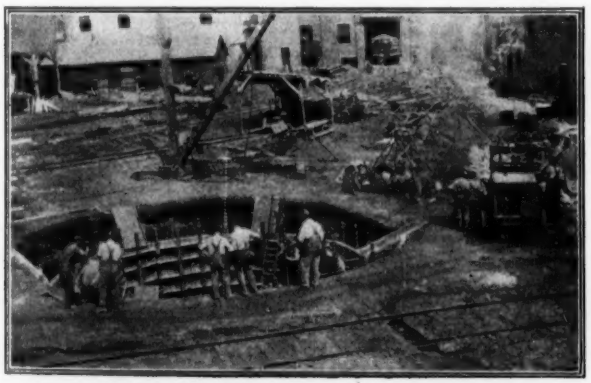


CONCRETE RINGS SUNK AND EXCAVATED INSIDE TO FORM WELL

The sinking of the third ring was attended by considerable difficulty. At 33 ft. depth a stratum was encountered, consisting of loose boulders which refused to slide in to the center, but remained under the edge. Long bars failed to dislodge the obstruction, and several sticks of dynamite were exploded in the water without effect. Two attempts were made to pump the pit dry, and to this end a 2500-gal. centrifugal pump was set up, near the water line. This succeeded in lowering the water about 10 ft., but could do no more, so the rig was removed and digging with the clamshell resumed. Eventually, when the hole in the center had been deepened, the obstructions slid from under the edge.

No difficulty was encountered in the construction of the remainder, except that of caving ground outside the forms and rings, the hole there enlarging itself from the original 30 ft. to nearly 60 ft., but the concrete rings remained truly plumb. The concrete in the final section was placed two months from the date of commencing. The top of the well was a 6-in. slab supported by two 15-in. 42-lb. I-beams placed parallel, 8 ft. apart, and was poured after the completion of the pump pit and house. It was designed for 250 lb. per sq.ft. and was reinforced across the beams by ⅝-in. rib bars spaced 10 in. apart and parallel to the beams by ¾-in. bars spaced at 12 in. to prevent expansion cracks.

The pump pit, 11 ft. 3 in. x 24 ft. x 24 ft. deep, was excavated, protected by wooden sheet piling and poured in three sections from the bottom up. The walls are 18 in. thick, reinforced by ¾-in. rib bars, as shown in the section, and waterproofed by the integral method, using Trus-con waterproofing paste. A beam 16 x 16 in., reinforced by ⅝-in. bars, three at the bottom and two at the top, is provided to take the thrust of the earth on the walls. The house over it, intended to hold the hose reel and other fire-fighting equipment, is of brick. In the pit is a unit, consisting of a 1000-gal.



CONCRETE IS BEING PLACED FOR SECOND RING

De Laval centrifugal pump direct-connected to a 50-hp. G. E. motor, with provision for another unit of 2000 gal. capacity, connected by a Y-branch to the 12-in. line supplying the steel tank. The level of the water in the tank is maintained automatically, there being provided a Cutler-Hammer float control for this purpose. Connection from the well to the pit is furnished by two 8-in. and one 12-in. pipe, of which one 8-in. is in use, while the others are in reserve, one for the 2000-gal. unit and the other for a proposed motor-driven fire

FIRST RING HAS DROPPED TEN FEET INSIDE EXCAVATION

pump. The intake extends about 12 ft. below normal water level and is provided with an 8-in. foot valve. Each intake is provided with a 34-in. slot in the wall of the well to allow for any future settling. The pit is provided with a 3-in. vertical Fairbanks-Morse sump pump, direct-connected by a long vertical shaft to a 5-hp. Fairbanks-Morse motor, located at the ground level.

The cost of the well was as follows:

Material:	
Sand, gravel, cement, form lumber, door, etc	$1,233.43
Rental of hoist, derrick, etc	750.00
Reinforcing and other steel	583.50
Brick for pumphouse	110.20
Steel sash	60.00
Roof	51.00
Labor:	
Excavation, concreting, doors, roof, etc	3,154.48
Bricklaying	181.60
Total cost of well and pumphouse, exclusive of all equipment	$6,124.21

The well has been in use for nine months and has given fullest satisfaction. It is noteworthy that no appreciable movement has taken place in the shell since its completion. The work was done by the forces of the Mead Pulp and Paper Co., of which E. F. Bearce is Chief Engineer.

Akron Water-Waste Survey Finds Loss in Large Meters

Isolation by Sections at Night To Test Mains—Day Tests Detect Service Leaks—Few Underground Leaks

FOLLOWING an expensive pitometer water-waste survey in Akron, Ohio, in 1916, it was concluded that the water unaccounted for was passing through large meters rather than through leaks in the mains. The results are given in the annual report of G. Gale Dixon, civil engineer, to H. H. Frost, superintendent of the Akron Water Department, from which these notes are taken.

Unrecorded use of water through factory meters totaling 586,000 gal. per day was discovered by pitometer survey and rectified. Cash adjustments for the above amounted to $3560, including one adjustment amounting to $2214, which has been agreed upon, but which has not yet been paid. The annual revenue from this quantity of water at the present maximum rate of 90c. per 1000 cu.ft. amounts to $25,820.

Hose-and-meter tests of street mains and service connections to date have resulted in the location of nine small leaks which were estimated to total 32,500 gal. per day and valued (at present minimum rate) at about $1600 per year.

The receipts for sale of water, which this year total over $350,000, represent approximately 50% of the water which is filtered and pumped.

If the present rate of setting domestic meters is continued, Akron will be completely metered next year; but the consequent reduction in household waste is not likely to increase the percentage of water accounted for to more than 60%.

Low Underground Leakage in Akron

Underground leakage from mains and services, which in some cities is a very large item, in Akron amounts to only 10% of the total pumpage.

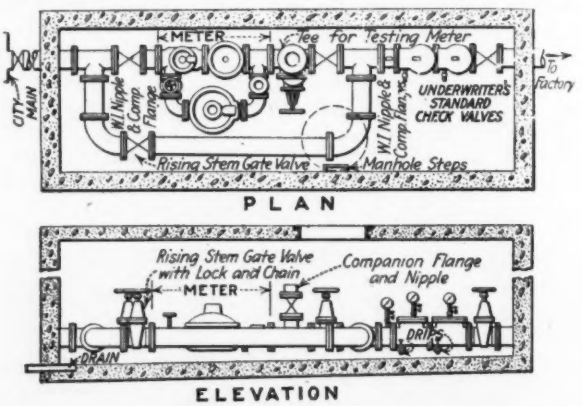
Assuming that 5% of the total pumpage is used for the flushing of streets and sewers, the extinction of fires, for watering-troughs and other public uses, an unaccounted-for balance of 25% remains. Results indicate that at least the major portion of this water can be transferred from the dead-loss to the revenue-producing side of the account by careful attention to the large connections.

The method of procedure on the night work was as follows: A section containing 10 or 15 squares was gated off and the highest hydrant opened to prove that the section was tight; great trouble was sometimes encountered in "drying up" a section, but it was always required, as any other method leaves the results open to serious question. After a section was proved tight, it was cut in to the instrument, the flow recorded and readings taken on the meters of all shops that were operating in the section. An adjacent section was then tested for tightness and added in to the one under observation, the building-up process being considered preferable to the reverse system used in some cities, due to the advantage of having smaller sections to test for dryness.

In daylight the hose-and-meter test was applied on the smallest section of main that could be isolated and included a fire hydrant. The equipment consists of 600 ft. of 2½-in. fire hose with meter board, consisting of a straight run of 2-in. pipe, a meter and a gage on a by-pass line, valves being inserted in the straight run and also on each side of the 1-in. meter. A hydrant cap tapped for 1-in. pipe and valve is used for a blow-off on the hydrant, and miscellaneous equipment includes miner's compass, aquaphones, valve keys, picks, shovels, etc.

Notification of Shut-off Given

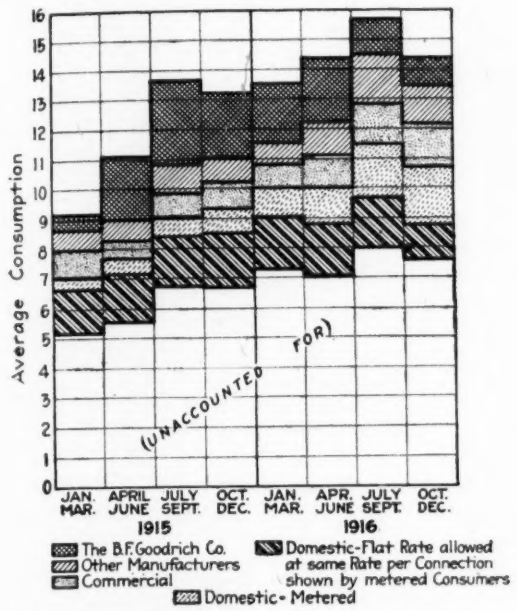
Two men first go through the section to be tested, notifying the people of the proposed shut-off. At the same time two other men test for leakage the hydrant through which the section is to be fed, and close the valves isolating the section. If the hydrant is found in good condition and the section dry, a valve is opened to supply the section. The hose and meter are then unloaded and one man connects up and opens the hydrants (first flushing the feeding hydrant) and closes the remaining street valve. While this is being done the other man, with the two men who have notified the people of the shut-off, proceed to close off the services. In this work two men take opposite sides of the street while the third man assists in locating the boxes and keeps notes of the conditions found. Each of the men



FACTORY-METER INSTALLATION REQUIRES DOUBLE CHECK VALVE AND TEE FOR TEST METER

closing the services is equipped with a curb box, key, aquaphone and flashlight. After removing the top from the box, he listens with an aquaphone at the curb cock. If he hears nothing, he closes the valve and listens again to make sure that the curb cock is closed. If he hears a flow when he first listens at the curb cock, he goes inside the house and closes the stop and waste cock; if he still hears the flow, he takes out the meter and caps the pipe. If the flow continues, there is a leak between the curb cock and the meter. If he does not hear it after taking out the meter, it is dropped, as it is going through the meter and is being paid for. If the curb box cannot be found, or if the curb cock cannot be closed, the stop and waste is shut. Three men are required, as considerable work is entailed in shutting off services due to the large size of sections between valves and the poor condition of curb boxes.

After all the services are shut off, the valve in the main line of the test board is closed, the water allowed to pass through the meter on the bypass, and the rate of flow observed. In general, flow at rates less than 0.05 cu.ft. per min. is neglected. In the case of greater flows, the foreman uses his judgment in searching for possible leaks, considering the size of the section, the


Average Consumption
(UNACCOUNTED FOR)
JAN. MAR. APRIL JUNE JULY SEPT. OCT. DEC. JAN. MAR. APR. JUNE JULY SEPT. OCT. DEC.
1915
1916
The B.F.Goodrich Co.
Other Manufacturers
Commercial
Domestic-Flat Rate allowed at same Rate per Connection shown by metered Consumers
Domestic-Metered

SEGREGATED USES OF WATER SHOW MUCH UNACCOUNTED FOR AT AKRON, OHIO

rate of flow, paved or unpaved streets, etc. After the test, the water is again turned through the main line of the test board, while two men turn on the services and the other two men open up the section, close hydrants and take down and load apparatus.

Coincident with the requirement that manufacturers install check valves at shops provided with dual water systems, the insertion of tees in the lines behind the meters was requested. This affords opportunity for the attachment of hose and meter at the most convenient point for test purposes.

Results From Selected Districts

Projecting the results to Jan. 1, 1917, over the whole city by applying the total leakage measured per mile to pipe and per inch-mile to the totals of these quantities as shown by the records, gives totals of 1,140,000 and 1,510,000 gal. daily respectively, as indicating the total underground loss from the distribution system. As the results have been obtained in selected districts, it is unlikely that the higher figure is actually exceeded, though the existence of relatively large leaks is possible in Districts 1 and 2, in which the distribution of the night rate is not known at present.

A comparison of the Akron results with those obtained at Cleveland, where waste-detection work has been in progress for nearly 15 years, indicates that in Cleveland an underground leak is located for every ½ or ⅝ mile of main tested, while the Akron work has resulted in the location of but one leak to each 1¼ mile.

Water-Works Plant 3,600,000 Trees in New York State

From 1909 to 1917 Conservation Commission Supplied Trees to Nearly 30 Water-Works for Reforesting Watersheds

ENCOURAGED by the State Conservation Commission, which has supplied nursery stock at cost, more than 3,600,000 of trees have been planted on the water-works drainage areas of 21 municipally owned and 7 privately owned water-works in New York State during the last nine years. About 30% of the total has been planted by New York City and 20% by Rochester. At the other extreme is Ogdensburg, with a planting of 1000 trees.

The number and varieties of trees planted are given by years for each water-works in the accompanying table. Pine make up some 3,200,000 of the total, of which nearly half are white, more than a third are Scotch, an eighth red and the balance Austrian. Norway spruce count up to nearly 300,000. This leaves about 50,000 divided among Carolina poplar, black locust, white cedar, European larch, white ash and basswood, in the order named. Presumably white pine would be still farther ahead had not the rust discouraged its use in the last two or three years.

The table given was compiled for *Engineering News-Record* through the courtesy of George D. Pratt, commissioner of conservation, and B. H. Paul, state forester of New York.

REFORESTING BY MUNICIPAL AND PRIVATE WATER-WORKS IN NEW YORK STATE, 1909 TO 1917

Place	Year	Species	Number
Canajoharie	1915	White pine	100,000
	1916	White pine	30,000
	1916	Red pine	20,000
			150,000
Carthage	1910	Scotch pine	6,000
	1911	Scotch pine	10,000
	1912	Scotch pine	10,000
	1913	Scotch pine	10,000
	1914	Scotch pine	10,000
	1916	Scotch pine	70,000
	1917	Scotch pine	70,000
			186,000
Cortland	1914	White pine	6,000
	1914	Scotch pine	4,000
	1915	White pine	5,000
	1915	Norway spruce	8,000
	1915	Red pine	2,300
	1916	White pine	13,000
	1916	Norway spruce	2,000
	1916	Red pine	8,000
	1916	White cedar	2,000
	1916	White ash	2,000
	1917	Norway spruce	7,000
	1917	Red pine	8,000
	1917	White cedar	5,000
			72,300
Gloversville	1909	White pine	20,000
	1910	White pine	15,000
	1010	Scotch pine	25,000
	1910	Red pine	20,000
	1911	White pine	13,000
	1911	Scotch pine	5,000
	1912	White pine	30,000
	1913	White pine	20,000
	1914	White pine	10,000
	1914	Scotch pine	10,000
	1914	Red pine	20,000
	1915	Scotch pine	36,000
	1916	Scotch pine	75,000
	1916	Red pine	25,000
	1917	Scotch pine	10,000
			334,000
Johnstown	1910	White pine	20,000
	1910	Scotch pine	2,000
	1911	White pine	20,000
	1911	Scotch pine	2,000
	1911	White ash	2,000
	1912	Scotch pine	2,000
			48,000

De Ruyter	1914	White pine	1,000
	1914	White ash	2,000
			3,000
Elmira	1912	White pine	1,000
	1912	Norway spruce	10,000
	1916	Norway spruce	5,000
			16,000
Glens Falls	1910	White pine	60,000
	1910	Scotch pine	5,000
	1910	Norway spruce	25,000
	1911	White pine	50,000
	1911	Norway spruce	25,000
	1916	White pine	30,000
	1917	Scotch pine	2,500
	1917	Red pine	10,000
	1917	Norway spruce	10,000
			217,500
Hudson Falls *	1910	White pine	500
	1910	Norway spruce	3,000
	1909	White pine	5,000
	1911	White pine	1,000
	1911	Norway spruce	1,000
	1912	White pine	2,000
	1912	Scotch pine	2,000
			14,500
Dion	1910	White pine	3,000
	1910	Scotch pine	1,000
	1910	Red pine	1,000
	1910	Norway spruce	3,000
	1911	White pine	3,500
	1911	Norway spruce	10,000
	1911	European larch	500
	1913	Scotch pine	5,000
			27,000
Lowville	1910	White pine	500
	1910	Scotch pine	1,500
	1911	White pine	2,000
	1912	White pine	5,000
	1913	White pine	5,000
	1914	White pine	5,000
	1914	Scotch pine	2,000
	1915	White pine	2,500
	1915	Scotch pine	1,500
	1915	Red pine	2,500
	1916	White pine	2,500
	1916	Scotch pine	1,000
	1916	Red pine	2,500
	1917	Scotch pine	3,000
	1917	Norway spruce	2,500
	1917	Red pine	5,500
			44,500
Malone	1914	White pine	3,000
	1915	White pine	1,000
	1915	Scotch pine	4,000
	1916	White pine	1,000
	1917	Scotch pine	3,000
			12,000
New York City †	1912	White pine	60,000
	1912	Scotch pine	35,000
	1912	Austrian pine	48,000
	1912	Red pine	15,000
	1912	Norway spruce	10,000
	1912	European larch	2,000
	1914	White pine	22,000
	1914	Red pine	32,000
	1914	European larch	2,000
	1914	Carolina poplar	25,000
	1915	White pine	60,000
	1915	Scotch pine	40,000
	1915	Scotch pine	5,000
	1915	Norway spruce	5,000
	1916	White pine	35,000
	1916	Scotch pine	10,000
	1916	Norway spruce	5,000
	1917	Scotch pine	85,000
	1917	Red pine	65,000
			561,000
New York City ‡	1912	White pine	50,000
	1912	Scotch pine	125,000
	1912	Red pine	20,000
	1912	Norway spruce	10,000
	1912	European larch	2,000
	1913	White pine	30,000
	1913	Scotch pine	205,000
	1913	Austrian pine	35,000
	1914	White pine	20,000
	1917	Norway spruce	20,000
			1,078,000
Norwich *	1911	White pine	4,500
	1911	Norway spruce	5,000
	1912	White pine	10,000
	1912	Norway spruce	5,000
	1912	Black locust	1,000
	1916	White pine	5,000
	1917	White pine	5,000
			35,500
Salamanca *	1910	Scotch pine	500
	1911	White pine	4,000
	1911	Scotch pine	2,000
	1911	Norway spruce	6,000
	1914	White pine	8,000
			20,500
Saugerties	1916	White pine	5,000
	1917	Red pine	5,000
			10,000
Salamanca	1911	White pine	1,200
	1912	White pine	60,000
	1912	Scotch pine	5,000
	1912	Norway spruce	10,000
			76,200
Ogdensburg	1912	White pine	1,000
Oneonta	1911	White pine	2,000
	1911	Norway spruce	3,000
	1912	Norway spruce	7,000
	1912	Carolina poplar	1,000
	1913	White pine	7,000
	1913	Scotch pine	5,000
	1913	Carolina poplar	1,000
	1915	White pine	7,000
	1915	Scotch pine	7,000
	1915	Norway spruce	500
	1915	Red pine	
	1916	White pine	15,000
	1916	Scotch pine	15,000
	1916	Red pine	20,000
	1917	Red pine	1,150
	1917	Scotch pine	50,000
			141,150
Ossining	1912	Scotch pine	2,000
Port Jervis *	1912	Scotch pine	25,000
Rochester	1909	White pine	20,000
	1910	White pine	1,000
	1910	Scotch pine	10,000
	1911	White pine	13,000
	1911	White pine	17,000
	1911	Norway spruce	30,000
	1912	White pine	62,000
	1913	White pine	71,000
	1914	White pine	30,000
	1914	Scotch pine	25,000
	1914	Red pine	30,000
	1915	White pine	125,000
	1915	Scotch pine	50,000
	1915	Red pine	81,000
	1916	White pine	100,000
	1917	Red pine	100,000
			765,000
Sidney *	1910	White pine	6,500
	1911	White pine	7,000
	1912	White pine	2,000
	1916	White pine	5,000
			20,500
Southampton	1915	White pine	3,000
	1915	Norway spruce	3,000
			6,000
Troy	1913	White pine	100,000
	1913	Scotch pine	50,000
	1913	Austrian pine	15,000
	1913	Norway spruce	30,000
	1913	White ash	2,000
	1913	Black locust	8,000
	1913	Red pine	25,000
			230,000
Unadilla *	1916	White pine	1,000
	1916	Red pine	1,000
			2,000
Waterville	1910	White pine	20,000
	1910	Scotch pine	5,000
	1911	White pine	2,000
	1911	Scotch pine	2,000
			29,000
Utica *	1915	White pine	30,000
	1915	Norway spruce	15,000
	1915	White cedar	5,000
	1915	Black locust	5,000
	1915	Basswood	500
	1916	White pine	5,000
	1916	Scotch pine	5,000
	1916	Norway spruce	5,000
			70,500
Grand total			3,637,100

* Water-works owned by private company. All others owned by city.
† Department of Water-Supply, Gas and Electricity.
‡ Board of Water-Supply.

Lime Discovered in Alaska

Discovery of a limestone deposit is reported by the Alaskan Engineering Commission. It is located near the Government railway and 102 miles from Anchorage. It is found to be suitable for building purposes, and to contain 94.68% of calcium oxide (quicklime) or 67.62% of pure calcium. It was discovered by S. F. Rhodes, of Anchorage, and is being worked. The lime is sold at $3.75 per bbl., which is approximately the freight rate on lime from the States. Several contractors have placed orders. The Commission is arranging to use it, and reports that if it continues to be satisfactory and can be secured in sufficient quantity no more lime will be imported.

Missouri Cities Experiment with Vacuum Street Cleaners

Machines Pick Up Street Dirt and Haul to Dump—Center and Gutter Machines Used—Streets Must Be Dry

STREET-CLEANING by the vacuum-cleaner system has been on trial recently at Kansas City and St. Louis, Mo. The machine consists of a four-wheel motor truck which carries the machinery and hauls a closed wagon into which the dirt is discharged. This outfit hauls the dirt to the dump. One of the machines is shown in the accompanying view. They are owned and operated by the Way-Cleanse Co., of Sandusky, Ohio.

Two Machines Used at Kansas City

Two machines cover a district of 124 blocks, with about 2,040,000 sq.ft. of pavement. They start at 7 p.m., and finish the work usually in about eight hours. Fred. A. Richardson, street cleaning commissioner, says that in the first 30 nights they removed 497,134 lb. of dust, dirt and litter. Of this, 40% was fine dust.

A patrolman attends the machine to handle the space around dead cars, and also to pick up wet or damp material which is placed in a large garbage can hung on the back part of the machine.

This district was formerly cleaned by 140 patrolmen, but with the machines this number has been reduced 50%. The character of the pavement is mainly asphalt and wood block, with a few blocks of Medina stone in good condition.

The gutter machine travels 2 miles per hour and must make two cuts. The center machine runs 5 miles per hour and makes as many cuts as are required with the 8½-ft. width of the cleaning device. On Grand Ave., for instance, 11 cuts are necessary.

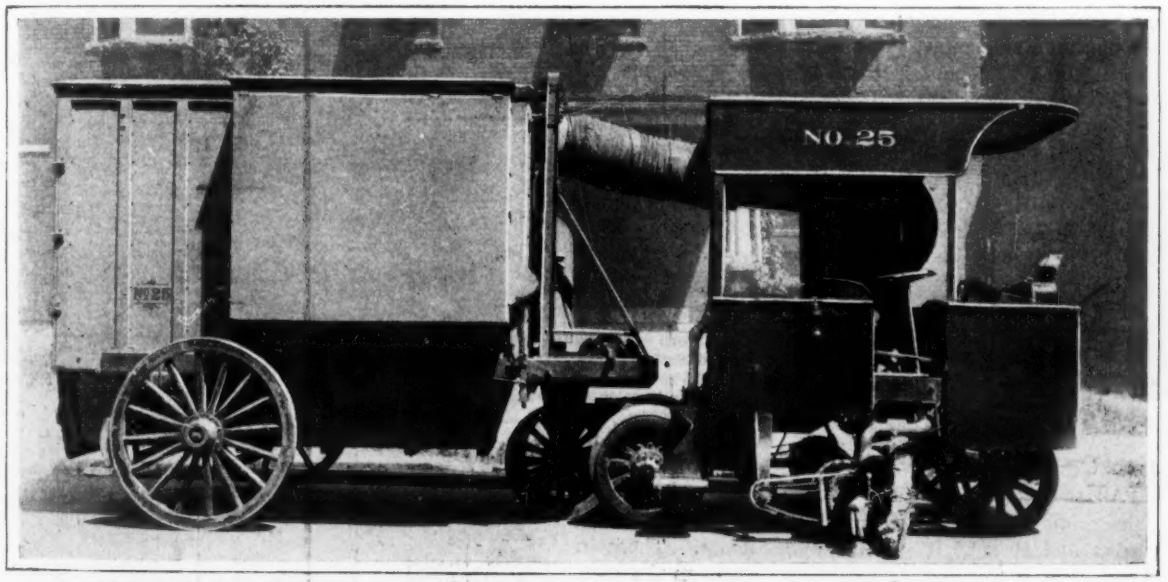
The wagon holds 20,000 lb. or about 9 cu.yd. of dirt. The fine material is heavy, due to the excessive amount of sand used on street railway tracks because of the steep hills in Kansas City. This sand wears the machine quite badly. In 27 nights the blower blades are cut out (see view) although they are ⅜ in. thick. Wood is to be tried. The back part of the fan is of ¼-in. boiler plate, but it is cut out in about the same time. The bass broom must be renewed in about 20 nights. Before the war these brooms cost $30; now the price is $106.

THESE FANS PICKED UP 497,134 LB. OF STREET DIRT IN KANSAS CITY IN 30 NIGHTS

A flexible pipe 12 in. in diameter and 62 in. long connects the sweeper to the dirt box. It is of No. 4 duck canvas, with a spiral wire covering. It lasts but two nights. A lining of rubber is to be tried.

Although the machine is 23 ft. long it can be turned in a radius of 17 ft., as it has a 3-point suspension. It cannot be backed. The sweeper weighs 14,000 lb., and the wagon or trailer 7000 lb.

The machines used at St. Louis, Mo., clean 140 blocks of congested district each night, between 7 p.m. and 5 a.m. About 40% of the material will pass through a 200-mesh sieve. There are 31 blocks of poor granite-block paving. The remainder is in fair condition; it includes asphalt, wood-block and bitulithic. The rough



THIS MACHINE PICKED UP 300,000 LB. OF STREET DIRT IN KANSAS CITY AND HAULED IT TO THE DUMP IN 30 NIGHTS, JUNE 8 TO JULY 8, 1917

granite-block paving must be gone over twice and here the machines must be slowed down to one mile per hour. During the day this district is patroled by 60 men, as before, but this number may be reduced. The two machines cleaned the streets for nearly a year under contract ending in June, 1917. The contract has recently been renewed for a year. During the first contract the machines were out of commission only 6½ nights in 11 months.

A report on this work by C. M. Talbert, director of streets and sewers, in August, 1916, stated that the machines removed the fine and impalpable dust "which has been found by bacteriologists to be the germ-carrying part of street refuse." By cleaning every night, street sprinkling has been eliminated. This in turn lessens the skidding of automobiles on wet pavement. The use of the machines has materially reduced the labor required for cleaning sewer inlets and catch basins. The material removed from these has been reduced about 35%, and it is expected that the cost will be reduced about 50%.

Mr. Talbert considers that a disadvantage of the machine is that it cannot be used except when the roadway and gutters are perfectly dry. During the rainy season, therefore, street flushing may be necessary. He states that no complaints of dirt in the congested district were received in the 60 days the machines were in use, and that merchants and others had expressed the opinion that conditions, so far as dust is concerned, had improved.

Mill Construction Used for City Factory Building

Heavy Timber Framing for Plant Within Chicago Fire Limits—Good Lighting Insured by Large Window Area

APPLICATION of the mill-type fire-resistive system of timber structural framing for industrial buildings within the business district of Chicago is illustrated by a recent addition to the plant of the Victor Electric Company.

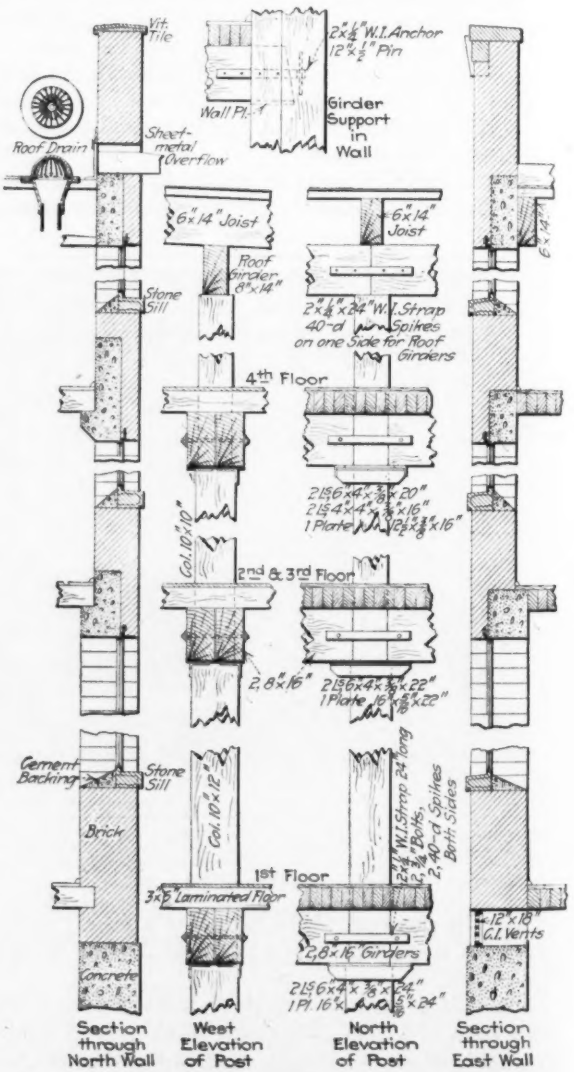
This type of construction was adopted on account of low cost and rapid erection. It is estimated that a reinforced-concrete structure would have cost 20% more and required 25% more time for erection. The cost of the building complete was 10c. per cu.ft. The building is for light manufacturing purposes, and there will be no heavy machinery to cause severe impact or vibration. For fire protection there is a sprinkler system on each floor.

The structural design which is typical for buildings of this class, is shown in the accompanying drawing. The building is 102 x 126 ft., with four stories and basement. The exterior walls are of concrete and pressed brick, with stone trimmings. The column spacing is 16 ft. on the longer side and 19½ ft. on the shorter side. Each column has a reinforced-concrete footing 7 ft. 4 in. square and 2 ft. deep, with two layers of steel bars in the bottom. The floor loads are 100 lb. per square foot.

Timbers Have Metal End Caps

All structural timbers are of long-leaf yellow pine. The columns are 10 x 12 in. for the first and second floors, and 10 x 10 in. for the upper floors. Those in the basement are seated on cast-iron shoes on the footings. The others rest on the built-up steel caps which carry the girders at each floor. The girders extend across the 16-ft. spans. Each floor girder consists of a pair of timbers 8 x 16 in., having their ends butted against the columns and seated on the column caps. For the first two floors, each column cap is composed of two side angles and a top plate, while those of the upper floors have four smaller angles and a top plate.

The ends of adjacent girders are connected across the column by a pair of outside straps with four spikes and two through bolts. Similar straps with anchors secure the ends of the girders in the wall pockets where they rest on steel plates. In accordance with standard practice the wall ends of the girders are cut at an angle, so that in case of fire burning out the columns the ends of the girders may tilt out of their pockets without



MILL-TYPE TIMBER CONSTRUCTION FOR FACTORY BUILDING WITHIN CHICAGO FIRE LIMITS

affecting the walls. No preservative is applied to the ends of the columns or girders, and no casting or finish is given to the woodwork.

The floors are of the laminated type, consisting of 3 x 6-in. timbers on edge, laid close and spiked together. They are not spiked to the girders, so that there is no interference of expansion and contraction movements in the girders and floors. At the end walls these floor timbers are carried by a 4-in. corbel. Upon this tight floor is a waterproofing layer of tar-paper and then the wearing surface of plank 1 x 3 in. A nosing strip secures the ends of these planks at the walls.

WINDOW AREA VERY LARGE

The roof has girders composed of single timbers 8 x 14 in., with ends resting directly on top of the columns and connected by straps spiked to each girder. Upon these are joists 6 x 14 in., spaced 8 ft. c. to c., carrying a sheathing of planks 3 x 6 in., laid flat and covered with composition roofing.

The window area is very large, and all windows are of the Fenestra type with metal frames and wire-glass panes. On two sides the window openings are 16 ft. and 12 ft. 3 in. wide. On the other sides their width is 4 ft. 10 in. Reinforced-concrete lintels are used, concealed by the pressed-brick facing, which is carried by a shelf angle on each lintel. An inclosed elevator shaft and inclosed stairway occupy two corners of the building. Electricity is supplied for lighting and power, and gas for furnace work.

This mill-type structural timber construction has been used in Chicago for several industrial buildings (for manufacturing and warehouse purposes) in the business districts. It meets the requirements of the underwriters, and the insurance rate on such a building is about the same as for one of reinforced concrete, where both are equipped with a sprinkler system.

The Victor Electric Co.'s building was designed by S. Scott Joy, architect, Chicago. The E. W. Sproul Co. was the general contractor.

Connecticut Controls Sewage Disposal

After years of delay the Connecticut State Board of Health has been granted a large measure of control over sewage disposal. An act passed by the last legislature empowers the board to "investigate all points of sewage discharge" and to "examine all existing or proposed public sewage systems and refuse-disposal plants," and to "compel their operation in a manner which will protect the public health." The board may order changes, extensions or "replacement by other structures when necessary for the protection of the public health." Hereafter no public sewerage systems or refuse-disposal plant may be built without a plan having been filed with and approved by the State Board of Health. Limitations on the new legislation exclude control over sewerage systems owned and maintained by persons or private corporations, and also publicly owned sewerage systems built or under construction, or systems plans for which had been approved by the board before the passage of the act—provided that the exceptions noted "shall not permit the continuance or increase of any pollution of the waters of the state which is prejudicial to the public health."

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

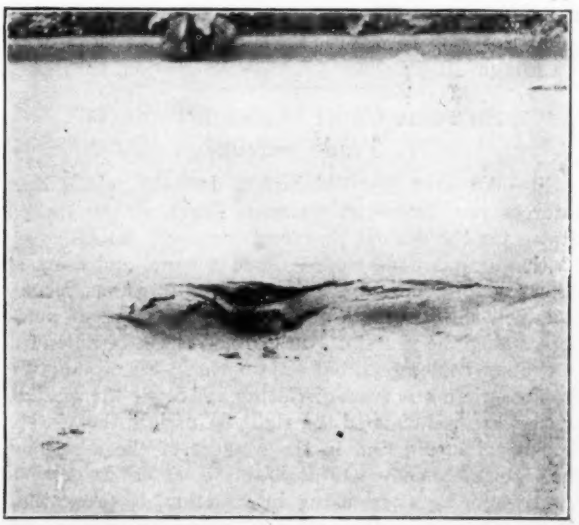
Bituminous Foundations for Sheet Asphalt Surfaces

Sir—The writer has noted with much interest the various comments in regard to his recent article on bituminous concrete base construction, and desires to correct any impression, conveyed by Mr. Roberts' letter, as to the unusual conditions attending the quality of the portland cement concrete foundation under asphalt pavements, the behavior of which was cited under heavy traffic.

It is likely that pavements constructed upon poor portland cement concrete foundation would be affected most readily by heavy truck traffic, and as the observations of the writer were not extended to the quality of concrete during construction of those pavements noted, the possibility of some deficiency in the character of concrete is, of course, pertinent.

The particular pavements in mind, however, are evidently not those constructed under the conditions referred to by Mr. Roberts, as they were laid prior to 1916, and, to the writer's best knowledge, with fresh aggregate. It is also fair to state that these pavements are of the lighter construction, in which the concrete base is only five inches thick.

That this condition is not isolated nor confined to portland cement concrete base under sheet asphalt will be apparent to anyone observing paving construction in Chicago, where there are numerous instances of failure



BASE DOWN EIGHT YEARS BEFORE FAILURE OCCURRED

of this type of base under both brick and wood block pavements—in fact, such failures of base seem to be more widely spread and apparent under block pavements than under sheet asphalt. Further, this condition is not confined to one city, but has been reported from various sources, including New York City, where men-

tion was made in a recent article by Mr. Stern, Chief Engineer, Borough of Manhattan, of the effect of unusual loads upon various classes of pavements. Naturally, however, this condition will be observed earlier, in the larger cities, where streets carry extremely heavy traffic.

In this connection, an interesting observation was made by the writer upon the sheet asphalt pavement laid on Cortland Street in Chicago, during the year 1909. This pavement has given excellent service since it was laid, but within the last couple of months a break has occurred in the surface, through failure of base, and presumably from some heavy load. A photograph of this break, noted shortly after it occurred, is given herewith. This pavement is of the type "A" construction: that is, 6 in. of concrete, 1½ in. of binder and 2 in. of top, and for eight years has displayed no weakness due to foundation or other trouble. The recent break, after so many years, is hardly indicative of any original weakness of the concrete in the base.

Great stress has been laid upon the ability of portland cement concrete foundation to bridge soft spots in the subgrade. It is these concealed or hidden soft spots which apparently are likely to become the source of greatest difficulty under increasingly heavy traffic. This point has been well covered by Mr. McGrath in a letter on p. 369, issue of Aug. 23. It might be added, however, that should such defects occur in a subgrade covered with bituminous concrete, and be undetected at the time of construction, later settlements can be very readily repaired with surface heaters, thereby building up the surface, rather than reconstructing the base as is necessary where portland cement concrete crushes through such weak subgrade.

The writer does not believe that all kinds of subsoil will permit of bituminous concrete base, and that its application must be restricted to conditions set forth in the original article.

L. KIRSCHBRAUN,
Director, Chicago Paving Laboratory.

Chicago, Ill.

Supreme Court Decision Protects Trade Secrets

Sir—We have just obtained a decision, which may interest you, from the Supreme Court of the United States for the duPont Powder Company. An employee of the company developed trade secrets and learned others during confidential employment by the company, and then threatened to go into the same line of business, using the secrets. He claimed those he intended to use are not secrets, but are known in the trade. We sued to enjoin him from disclosing and using the secrets, and his counsel claimed the right to disclose the secrets to experts to aid him in the conduct of the case, and the right of his client to disclose the secrets to persons from whom he was seeking information, to prove that the secrets are in the realm of public knowledge and therefore not secrets.

The trial court granted us a preliminary injunction against this disclosure, and the Court of Appeals in Philadelphia handed down an opinion holding that the trial court should not have granted this injunction. We obtained a stay of the mandate while we petitioned the Supreme Court of the United States for a writ of certiorari, thus leaving the injunction in force, and the Supreme Court granted the writ, directing the Court of Appeals to send the case to the Supreme Court. The late John G. Johnson of Philadelphia filed a brief against us, but he died before the date set for the hearing, and George Wharton Pepper, of Philadelphia, made the argument against me.

The Supreme Court has just handed down a decision reversing the Court of Appeals and sustaining the injunction. The case is of large importance because if the contentions on behalf of the defendant had been sustained, he could have destroyed the secrets in the process of trying the case, and thereafter no manufacturer would have brought suit to protect trade secrets, since he would rather have allowed one dishonest employee to use them than to have permitted them to become known to the entire trade.

EDWIN J. PRINDLE,
Prindle, Wright and Small.

New York.

Machine-Bolt Heads Smaller Than Nuts

Sir—All of the steel manufacturers' handbooks, so far as I know, as well as Kent and others, give obsolete standard tables for dimensions of machine-bolt heads in making them the same dimensions as the nuts. The manufacturers' standard dimensions of bolt heads with which orders for machine bolts are filled, are in every case smaller than the nuts. There are good reasons for this standard, in part as follows:

The head, which has no hole in it, should not be as big as the nut, which does, in order to be as strong.

The smaller head is cheaper to make, occupies less space in packages and costs less for transportation.

It saves in the number of wrenches required with square heads and nuts, because the head can be held from turning by the wrench for the nut of the next smaller size bolt and wrenches are commonly made loose enough so this can be done.

F. D. BUFFUM,
Pittsburgh, Penn. General Contractor.

[It is true that many handbooks give only the Franklin Institute or American Bridge Co. standards, showing the nuts and bolt heads equal in size, or differing only in thickness. Some of the newer editions, however, are including the manufacturers' standards, which certainly should be done, as they govern the dimensions of commercial machine bolts.—Editor.]

More Lead Produced in 1917

More than half as much lead was produced during the first six months of this year as during the entire twelve months of 1916, according to figures compiled by C. E. Siebenthal of the U. S. Geological Survey. The increase is due mainly to a marked increase in lead of foreign origin. The domestic output was 276,523 tons, as compared with 276,114 tons, half the corresponding output for 1916. The output from foreign sources, however, was 29,529 tons, as compared with 9453 tons, half that for 1916. The apparent consumption of lead in this country during the six months was 268,952 tons, as compared with 230,587 tons, half the consumption during 1916. The average outside spot price during the six months' period was 9.9c. per pound, as against 6.9c. in 1916.

THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

"Go-Go" Semaphore Shades Policeman

COLUMBUS, Ohio, and some of the other more southern cities, provide traffic signals that are useful in more than one way, as the accompanying illustration shows. Two octants of the umbrella are colored red and

MAKES TRAFFIC OFFICER MORE EFFICIENT

lettered "stop"; the octants at right angles are white and marked "go." The intermediate octants bear the name of "Columbus Automobile Club," which is presumably responsible for the idea.

Formulas Deduced for Friction Loss in Water Pipes and Fittings

SOME exponential formulas for the friction loss of head of water flowing through standard American pipes and fittings have been deduced by Prof. F. E. Giesecke, head of the Division of Engineering, Bureau of Economic Geology and Technology, University of Texas. These are some of the results of experiments made at that institution under his direction. (An outline of the tests was given in a paper before the July, 1917, meeting of the American Society of Heating and Ventilating Engineers; a full report will shortly be issued in a bulletin of the University of Texas.)

Briefly summarized, the method of test was to let water run from one tank to another, with and without the given pipes and fittings in the connecting line. The velocity was computed after calibrating the free area of the pipe, weighing the water flowing in a given interval, and measuring the difference of level by hook gages. In this way the head-velocity relations were established for various velocities in pipes of $\frac{1}{2}$ to 3 in. nominal size. After plotting these relations on double logarithmic cross-section paper the loss per foot of pipe could be secured. Then a logarithmic plot was made of values of K in the equation

$$h = kv^n$$

for the several sizes of pipe. From these the final formula was deduced as

$$h = 0.00685 \frac{v^{1.75}}{d^{1.275}}$$

for water at 68° F. and for velocities of up to 3 ft. per sec., in $\frac{1}{2}$- to 3-in. black butt-welded steel pipe.

Similar studies of galvanized pipes gave the formula

$$h = 0.00845 \frac{v^{1.84}}{d^{1.75}}$$

In general, the exponent of v increases with the interior roughness of the pipe.

Increasing the temperature of the water decreased friction-head loss, apparently by changing the coefficient of v of the exponent. The hot-water experiments were not completed.

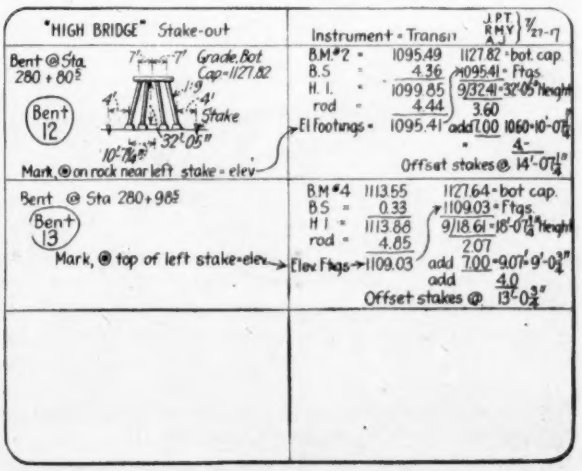
For the friction loss of flow at 68° F. through one standard short-radius steam elbow the formula deduced is

$$h = 0.0141 \frac{v^{1.96}}{d^{0.26}}$$

Bridge Stake-Out Simplified by a Clear Form of Notes

BY E. P. ARNESON
San Antonio, Texas.

THE following form of note keeping for stake-outs of bridge bents has been found simple, quickly made and of ready reference on the job. If the bridge is on a grade, it is necessary to have available, preferably



RECORD BRIDGE STAKE-OUT OPERATIONS IN THIS MANNER

in the same notebook with the stake-out records, the information indicated in the accompanying table.

DATA ON "HIGH BRIDGE"

Station	Bent No.	Grade (1%) Floor Surface	Bottom of Cap
280+80.5	12	1,129.82	1,127.82
280+98.5	13	1,129.64	1,127.64
281+16.5	14	1,129.46	1,127.46

With the above data and benchmark levels readily accessible, the staking out of the bridge bents is undertaken, and the operations so performed are recorded in the manner suggested by the illustration of a typical field notebook opening.

How Design Knee-Braced Top Flange of Girder?

A correspondent submits a query regarding the proper use of column formulas and desires suggestions for rational methods of knee-brace design. The top flange of a through plate girder is stayed at regular intervals by knee braces riveted to the floor-beams. What length l should be used in the design of the top flange according to a specification stating that the unit stress shall not exceed $16{,}000 - 200l/b$, in which l is the unstayed length and b is the width of flange? Can the flange be considered as rigidly held by the knee braces? How should the knee braces be designed?

Grading and Ditching Costs but $23 a Mile in Oregon

With the equipment shown in the photograph Union County, Ore., did 127 miles of road work last year at an average cost of $23 a mile. The roads were all finished 30 ft. wide. According to the report of the county roadmaster, George Grout, the work, which occupied 160 days, included 47 miles of sidehill road where rock was encountered, 52 miles of earth road and 28 miles of existing road ditched on both sides.

The equipment used consisted of an Austin giant grader, 8-ft. blade, and a Western grader, 13-ft. blade, drawn by an Avery 40-80 gas tractor. At the conclusion of the work this equipment was overhauled and found to be in good condition, considering that much of the work done was very heavy.

The above costs include 15% of the first cost of the equipment as depreciation, oil, fuel, labor, and all repairs.

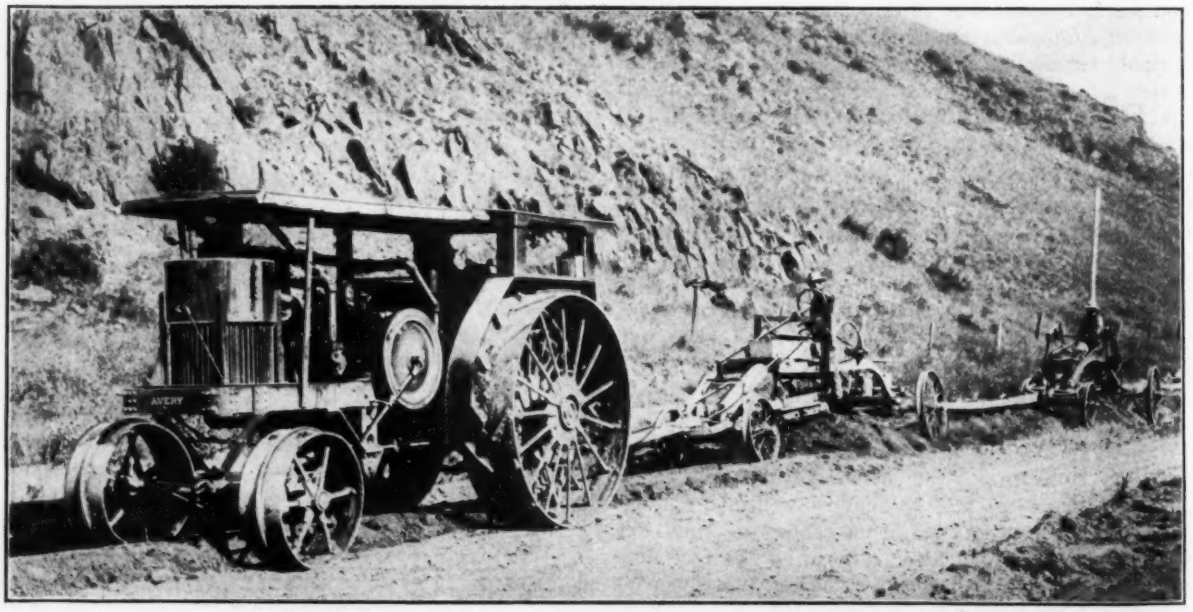
Table Gives Areas of Segments of Circles

There is frequent need for an easy formula for finding the area of a segment of a circle, since this area is needed in calculating the contents of horizontal cylinders for various depths of the liquid in the cylinder. The content of such a cylinder equals the area of the segment times the length of the cylinder.

No satisfactory formula has been developed for finding the area of circular segments in terms of the radius and altitude of the segment. All exact formulas involve the central angle subtended by the chord of the arc, and it is a difficult matter for a practicing engineer to make use of such formulas when the altitude of the segment alone is given.

A number of approximate formulas have been developed for finding the area of segments. The simplest one gives area as $\frac{2}{3}AL$, where A is the altitude and L is the length of the chord of the segment. This formula assumes that the arc of the circle corresponds to the arc of a parabola and gives quite close results when the altitude of the segment is less than one-fifth of the radius; it cannot be used when the altitude is over one-quarter of the radius. Other formulas for finding approximate areas of segments do not readily permit the use of logarithmic computation and, furthermore, are far from accurate.

The accompanying table has been constructed by Prof. W. B. Marquard, of Lafayette College, to give accurate areas of segments for various altitudes that range from one-sixtieth part of the radius up to the radius. It was first published in *Engineering and Mining Journal.*



OUTFIT DOES HEAVY GRADING AT LOW COST, COVERING 127 MILES IN 160 DAYS

The area of the major segment is found by subtracting the area of the tabulated small segment from the area of the circle (3.14159 R^2). Areas for various altitudes are found by multiplying numbers in the second column of the table by the square of the radius. Each division of the first column represents an altitude of one-sixtieth part of the radius. Hence areas are shown for every inch of 5-ft. circle, or for every 0.4 in. of a 2-ft. circle, etc.

AREAS OF CIRCULAR SEGMENTS

Formula used, Area = R^2 arc vers $\frac{h}{R} - (R - h)\sqrt{2Rh - h^2}$

Depth	Area / R^2	Log Area / R^2	Depth	Area / R^2	Log Area / R^2
1/60 R.	0.00408	$\bar{3}.61066$	31/60 R.	0.64320	$\bar{1}.80839$
2/60 R.	0.01145	$\bar{2}.05881$	32/60 R.	0.67252	$\bar{1}.82770$
3/60 R.	0.02091	$\bar{2}.32035$	33/60 R.	0.70216	$\bar{1}.84644$
4/60 R.	0.03211	$\bar{2}.50664$	34/60 R.	0.73209	$\bar{1}.86456$
5/60 R.	0.04478	$\bar{2}.65108$	35/60 R.	0.76224	$\bar{1}.88209$
6/60 R.	0.05872	$\bar{2}.76879$	36/60 R.	0.79267	$\bar{1}.89909$
7/60 R.	0.07381	$\bar{2}.86812$	37/60 R.	0.62334	$\bar{1}.91558$
8/60 R.	0.08993	$\bar{2}.95391$	38/60 R.	0.85424	$\bar{1}.93158$
9/60 R.	0.10705	$\bar{1}.02959$	39/60 R.	0.88535	$\bar{1}.94712$
10/60 R.	0.12502	$\bar{1}.09698$	40/60 R.	0.91670	$\bar{1}.96223$
11/60 R.	0.14376	$\bar{1}.15764$	41/60 R.	0.94821	$\bar{1}.97690$
12/60 R.	0.16350	$\bar{1}.21352$	42/60 R.	0.97991	$\bar{1}.99119$
13/60 R.	0.18387	$\bar{1}.26451$	43/60 R.	1.01180	0.00509
14/60 R.	0.20492	$\bar{1}.31158$	44/60 R.	1.04385	0.01864
15/60 R.	0.22666	$\bar{1}.35538$	45/60 R.	1.07610	0.03185
16/60 R.	0.24900	$\bar{1}.39620$	46/60 R.	1.10839	0.04469
17/60 R.	0.27190	$\bar{1}.43441$	47/60 R.	1.14087	0.05724
18/60 R.	0.29548	$\bar{1}.47053$	48/60 R.	1.17347	0.06947
19/60 R.	0.31957	$\bar{1}.50457$	49/60 R.	1.20619	0.08106
20/60 R.	0.34416	$\bar{1}.53676$	50/60 R.	1.23901	0.09311
21/60 R.	0.36945	$\bar{1}.56756$	51/60 R.	1.27193	0.10476
22/60 R.	0.39483	$\bar{1}.59641$	52/60 R.	1.30492	0.11559
23/60 R.	0.42083	$\bar{1}.62411$	53/60 R.	1.33904	0.12659
24/60 R.	0.44730	$\bar{1}.65060$	54/60 R.	1.37113	0.13708
25/60 R.	0.47418	$\bar{1}.67594$	55/60 R.	1.40433	0.14747
26/60 R.	0.50143	$\bar{1}.70021$	56/60 R.	1.43756	0.15763
27/60 R.	0.52910	$\bar{1}.72354$	57/60 R.	1.47083	0.16756
28/60 R.	0.55711	$\bar{1}.74594$	58/60 R.	1.50415	0.17729
29/60 R.	0.58549	$\bar{1}.76752$	59/60 R.	1.53746	0.18681
30/60 R.	0.61419	$\bar{1}.78830$	60/60 R.	1.57080	0.19612

Note—Areas for various depths of segments are found by multiplying numbers in the second column by the square of the radius. To facilitate the work of computation in making a table to show contents of tank for various depths the logarithms of the areas are given in the third column. The logarithms of the contents in cubic feet for the various depths are found by adding the sum of the logarithms of the length of the tank and twice the logarithm of the radius to the tabulated logarithm in the third column. The logarithm of the contents in gallons is found by adding the logarithm of length and twice the logarithm of radius and log 7.4805 to the tabulated logarithm in the third column (Log 7.4805 = 0.87393). When the depth is greater than the radius the area of the major segment must be found, which equals the area of the circle (3.14159 R^2), less the tabulated area of the small segment.

A table showing the contents of horizontal cylinders for various depths of the liquid can be easily made by using the following table of segment areas. The use of logarithms is urgently advised in making a table showing the contents of tanks. The following illustrations show a method of obtaining the contents in cubic feet and also in gallons:

Radius = 5 ft. Length = 12 ft. Log R^2L = 2.47712

Depth	Log. Volume, Cu.Ft.	Volume, Cu.Ft.
5/60 R = 5 inches	$\bar{2}.65108 + 2.47712 = 1.12820$	13.43
25/60 R = 25 inches	$\bar{1}.67594 + 2.47712 = 2.15306$	142.25
60/60 R = 60 inches	$0.19612 + 2.47712 = 2.67324$	471.24

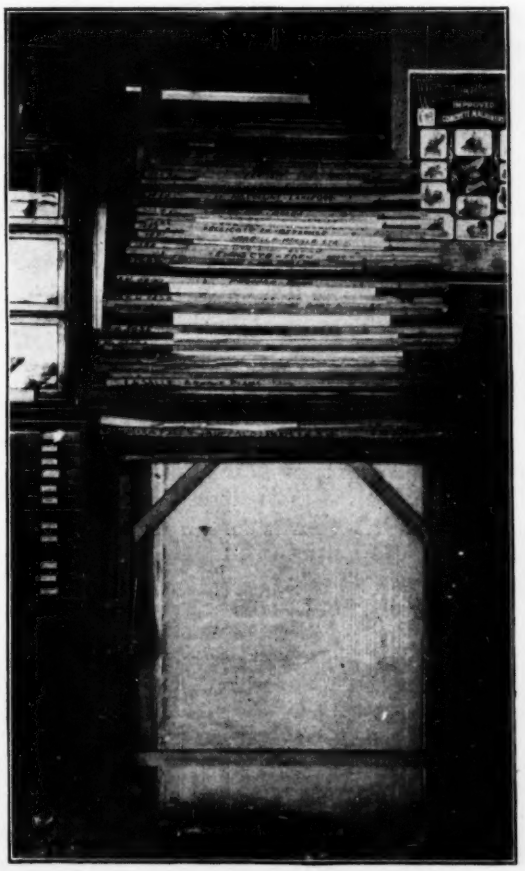
If it is desired to find the contents in gallons, add the log (7.4805 R^2L) to the tabulated logarithm in the third column of the table:

Radius = 3 ft. Length = 10 ft. Log. (7.4805 R^2L) = 2.82827

Depth	Log. Volume, Gal.	Volume, Gal.
5/60 R = 3.0 inches	$\bar{2}.65108 + 2.82817 = 1.47925$	30.15
25/60 R = 15.0 inches	$\bar{1}.67594 + 2.82817 = 2.50411$	319.24
60/60 R = 36.0 inches	$0.19612 + 2.82817 = 3.12429$	1,057.5

Large Number of Road Plans Filed in Simple Rack

THE accompanying photograph was taken in the office of George C. Diehl, County Engineer of Erie County, New York, at Buffalo, and shows the method of filing blueprint road plans of a large number of townships. The scheme consists merely of mounting the blueprints of each township between two stick or lath binders and hanging each pair of binders on an inclined rack. The titles and numbers of the roads are printed in black ink on one side of the binder sticks, and just enough inclination is given the rack so that the titles of all the binders are readable to one standing in front. Not only is convenience served, but the cost of the rock is negligible.



RACK INCLINED TO SHOW TITLES

Revision of English Standard Specifications

Periodical revision of specifications is the practice of the British Engineering Standards Committee. Each specification, according to a report of the Sectional Committee on Cast-iron Pipes for Gas, Water and Sewerage Purposes, "will, when necessary and at least annually, come up for revision." At such times "suggested amendments or enlargements will be considered and dealt with by the sectional committee, it being of a permanent character."

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

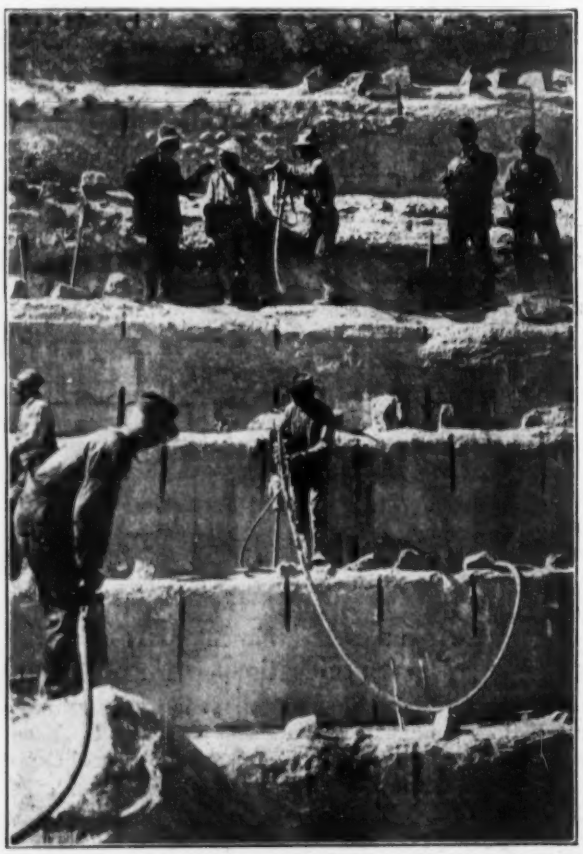
Five-Inch Holes Made with Hammer Drills on Dam Enlargement

By H. L. Hicks
New York City

THE RECONSTRUCTION and enlargement of three dams at Big Creek, Fresno County, California, to provide additional storage capacity, is marked by a method of anchoring the new concrete to the original reinforced-concrete structure of dam 2, which required drilling a large number of shallow, large-diameter holes.

The construction work is being conducted by the northern division of the Southern California Edison Co., whose chief engineer, R. C. Starr, devised a plan of using 6-ft. lengths of 30-lb. rail as ties, setting them vertically into the stepped back of the existing dam. This necessitated the drilling, at close intervals, of 5-in. holes 3 ft. deep. In fact, the practical success of the whole system was dependent upon the possibility of drilling the large number of these holes required with rapidity and at reasonable cost.

Owing to the unhandy location of the holes to be drilled, it was out of the question to use the heavy tripod-mounted piston drills usually employed for putting down large-diameter holes. E. L. Fox, superintendent in charge of the drilling, placed his faith in the ability of unmounted hammer drills to carry out the work, although nearly all the drill manufacturers were of the opinion that it would not be possible to handle bits as large as 5 in. in diameter because of the large number of very hard boulders which would be encountered embedded in the concrete. After experimenting with various kinds of bits and different machines, Mr. Fox finally selected Leyner-Ingersoll drills for this heavy duty, they having shown from 30 to 40% greater speed than others.



HAND DRILLS PUT DOWN LARGE HOLES FOR RAIL REINFORCING

Eight drills are in use. Of the type ordinarily used in tunnel driving on a column or bar mounting, the drills have been fitted for this work with special handles and are operated by two men as hand hammer drills. Standard 1¼-in. solid round steel is used with 5-in. bits. The Leyner water-feeding device has been dispensed with and the holes are drilled dry, the cuttings being cleaned out by means of an auxiliary blowpipe. The average drilling time for a 3-ft. hole is 20 minutes.

The duty on the drills is severe, and to relieve the strain as much as possible a Leyner sharpener, fitted with special dies to handle the large bits, was installed. Absolute gage perfection secured in this way relieves the drill rotation mechanism of excessive wear and has largely eliminated loss of time due to stuck steels.

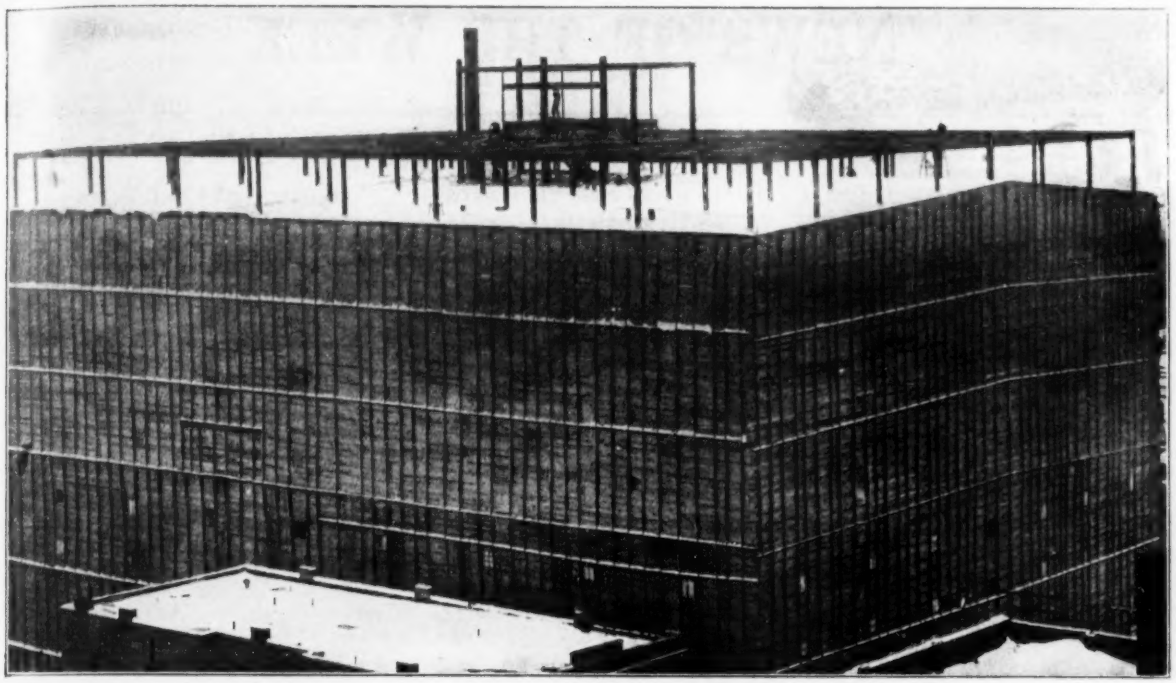
When all the holes have been drilled the lengths of rail will be grouted in and the forms set for pouring the new concrete.

Wooden House Incloses Steel Frame for Cold Weather Concreting

THE Furniture Manufacturers Building at Jamestown, N. Y., a 10-story steel skeleton structure with reinforced-concrete floors and brick walls backed up with hollow tile, was started last fall and for business reasons had to be continued through all of last winter. The temperature at Jamestown falls so low in the winter that it is necessary to have some protective covering inside which to place the concrete floors. The contractor, Charles P. Haas, of Jamestown, considered the use of canvas as ordinarily employed for such work, but found on analysis that lumber housing would prove more economical in the long run on account of its greater salvage value. Accordingly the whole structure was inclosed in a timber housing.

In the beginning of the construction it was decided to inclose the first four floors, as this was thought to be sufficient work to be accomplished through the winter months, but the work progressed so rapidly about the middle of January that it was decided to inclose to the ninth floor, leaving the top framing for spring.

The wooden walls were placed sufficiently far outside of the steel frame to allow for the erection of the



TIMBER FRAME HOUSE OUTSIDE STEEL BUILDING UNDER CONSTRUCTION KEEPS INSIDE TEMPERATURE 40° TO 50° F. ABOVE OUTSIDE

masonry inside. They were of simple stud and sheathing construction with cross plates as shown and braced against the exterior columns. Salamanders were used to furnish heat for the masonry and concrete floor work, there being about 26 in use practically all the time. Hard coal was used for fuel. The temperature in the building ranged from 35° to 50° F. right through the most severe winter weather, while outside the temperature registered as low as 28° below zero. The area of one floor is about 20,000 square feet.

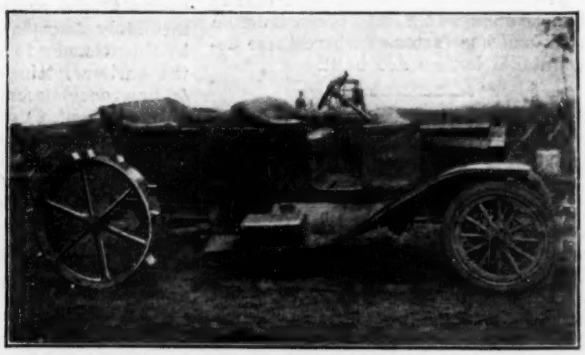
"Flivvers" with Cleated Back Wheels Pull Stumps at Army Camp Site

BY REMOVING the rubber-tired rear wheels from a number of Ford automobiles and replacing them with cleated metal rims as shown in the picture, the Thompson-Starrett Co. was able to expedite the work of clearing stumps from the site of Camp Upton, near Yaphank, N. Y., where the recruits for the National Army will be trained. The stumps are hooked up to the "flivver" by a chain or steel cable and are easily rooted out, as the trees are mostly scrub oak and pine of small

FOR THE BIG STUMPS A STEAM ROLLER WAS USED

HOW CAMP AREA LOOKS WHEN CLEARED AND READY FOR STUMP PULLING TO BEGIN

diameter. For bigger stumps a steam roller is used, as illustrated. With this machine sometimes half a dozen stumps are up-rooted at a single pull.



ONE OF THE "FLIVVERS" WITH CLEATED WHEELS WHICH SERVED AS A STUMP PULLER AT CAMP UPTON

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Demountable Wooden Houses Needed in France

Drawings and Specifications Are on File in the Office of the "News-Record"

A letter from Maj. Ernest McCullough, chief engineer of the American Red Cross, in Paris, to *Engineering News-Record* encloses a set of drawings and specifications for temporary wood houses to be built in the destroyed region of France. These projects are in charge of the Ministère de l'Interiure and inquiries regarding them should be addressed to that department in Paris. The single copies of the documents with the drawings can be seen at the office of *Engineering News-Record.*

The Government of France is now preparing for reoccupancy of the districts evacuated by the Germans and, as is well known, practically all of the cities have to be rebuilt. For the temporary shelter of the returning residents, however, small wood frame houses are provided. These are generally of a take-down type which are shipped in cut and fitted pieces to be erected on the site. Such houses, of four different types, are illustrated in detail in the drawings sent, and it is Maj. McCullough's opinion that American manufacturers may be able to go into the business of making them.

The cost of the houses is about $250 per room delivered at a port in France, from which they will be carried by the Government to their destination. On account of short freight cars the maximum permissible length of any piece is 6 m. or 19.7 ft. Hundreds of houses have been used and thousands will be required. Those now built in France and Switzerland are of green lumber, not always of the best quality. Furthermore, it is extremely difficult now to get timber in France over 5 x 10 in. in section. Anything larger is or has been taken by the armies.

The Society of Friends of England is also engaged in this reconstruction work and has factories where these demountable houses are built.

St. Paul Engineers Entertain Soldiers

The Civil Engineers Society of St. Paul, Minn., gave a dinner on Aug. 23 in honor of those members who have received commissions in the Engineer Corps of the United States Army. The officers included Maj. George W. Rathjens, Capt. William N. Carey, Capt. T. D. Sterling, and First Lieuts. W. K. Tanner, A. Montgomery and O. M. Rufsvold.

High Prices Cause Bid Rejection for Hetch-Hetchy Tunnel

Bids on a tunnel section of the new Hetch-Hetchy water-supply of San Francisco were rejected on Aug. 23 because the only complete bid was 47% more than the engineer's estimate. The section advertised for is 19 miles long and was estimated by City Engineer O'Shaughnessy to cost not more than $6,307,000. The only complete bid, by R. C. Storrie & Co., was $9,233,671. New bids will probably be asked for in the near future, although the conditions that bring about such high bidding will probably not change in some time.

Government Will Build Boat Repair Shop at Marietta, Ohio

The Secretary of War has authorized the purchase by the United States Government of a block in the City of Marietta, Ohio, as a site for a Government repair shop which will furnish supplies for the Ohio River Government fleet in the Wheeling district.

Montclair Paving Again Held Up by Litigation

The quarter-million paving job on Park St. and Belleville Ave., Montclair, N. J., is again held up by litigation. A few weeks ago the Town Commission, after receiving bids on various kinds of pavement, awarded the contract to the Standard Bitulithic Co. for "Warrenite," although the lowest bid was for "Topeka specification" pavement. Thereupon application for a hearing on a writ of certiorari was granted, on the ground that the law required the contract to be let to the lowest bidder. The commission let the case go by default and the court ruled against the commission. New bids, for "Warrenite" only, were asked for. The lowest of three bids for one of the streets and of two bids for the other was from the Standard Bitulithic Co., to which the contract was promptly awarded. Immediately four taxpayers, represented by the attorney for the lowest bidder at the earlier letting (Chapman, Harrop & Lawrence) secured an order for a hearing (Sept. 5) on a writ of certiorari —presumably on the ground that there was no real competition under bids calling for a proprietary pavement. Christopher Harrison is town engineer of Montclair.

Canada To Buy Canadian Northern

By a majority of 53 to 37 the Canadian House of Commons voted Aug. 31 to have the Dominion Government buy the Canadian Northern Railway.

Estimated Cost of Ships Outlined by Board

Secretary of Treasury Receives Estimate for Transmission to Congress

The United States Shipping Board has sent the following statement to the Secretary of the Treasury for transmission to Congress relative to the ship program:

BUILDING PROGRAM

	Number	Tonnage	Estimated Cost
Ships contracted for	433	1,919,200	$285,000,000
Ships ready to be contracted for when funds are available	452	2,968,000	455,500,000
Ships under negotiations	237	1,281,400	194,000,000
			934,500,000
Miscellaneous vessels	150	1,800,000	300,000,000
Organization and other miscellaneous expenses			35,000,000
Amount authorized by Congress June 6, 1917 ($300,000,000 appropriated)			550,000,000
Amount to be authorized for building program immediately in sight, making no allowance for changes in cost or labor and material			719,500,000

COMMANDEERING PROGRAM

For commandeered ships, amount required	515,000,000
For commandeered ships, amount authorized by Congress June 6, 1917	250,000,000
Balance requiring authorization by Congress	265,000,000

PURCHASE PROGRAM

For vessels to be purchased other than under construction or commandeered	150,000,000

SUMMARY

Total amount, in round figures, to be purchased in addition to amounts already authorized:	
For commandeered vessels	265,000,000
For construction of new vessels	719,500,000
For purchase of new vessels	150,000,000
Grand total	1,134,500,000
Amounts desired to be appropriated for remainder of fiscal year 1918:	
For commandeered vessels	365,000,000
For building program	400,000,000
For purchase of vessels	150,000,000
Total	915,000,000

King County, Wash., Turns Drainage Over to Its Engineer

Hereafter in King County, Washington, all drainage projects will be constructed under the supervision of the county engineer, by the terms of resolution adopted by the County Commissioners recently. It was pointed out to the board by S. J. Humes, county engineer, that in a number of instances the private engineers employed by the drainage district commissioners proceeded without considering the effect their work would have on public highways generally. In King County at the present time two big drainage projects are in contemplation, one at Bothell, on the north, and one at Pacific City, on the south.

Barge Transport Is Booming on Mississippi

With Aid of Government Effort Is Being Made to Develop River Traffic

Development of river transportation along the Mississippi, to meet conditions due to the war, has had some success and some difficulties. In May, 1917, the Mississippi Valley Waterways Association was organized, one of its principal objects being to develop immediate use of the waterways by such craft as might be available. The president is James E. Smith, of St. Louis, and Sydney J. Roy, of Hannibal, Mo., is secretary. The Federal Government, through Gen. W. M. Black, chief of engineers, turned over to the association 12 steel barges and two towboats.

Putting this equipment into service was found to be more difficult than had been expected, but the difficulties were finally overcome. Unlimited lumber tonnage from the Louisiana district was offered, and also 35 carloads of lumber to be transported into the territory north of the Ohio and through Missouri and Iowa. The lumber could be handled on the barges, which were without cargo houses, but the unlimited tonnage offered at St. Louis was all of a character requiring cargo houses for its protection. The Government having no funds that could be used to build these shelters, and the shippers not caring to build them for temporary use, it was impossible to handle the lumber because there was no return cargo from St. Louis that could go on a barge without a cargo house.

Attention was turned then to the upper Mississippi. Mr. Kavanaugh, of the Southern Coal Co., of St. Louis, was willing to join Mr. Goltra, of the Mississippi Valley Iron Co., of St. Louis, who needed iron ore from the Mesaba Range, a short distance from St. Paul. Through the above association they leased the towboats and barges from the Government. In the week ending Aug. 18 they succeeded in sending to St. Paul a tow of six barges, carrying 3500 tons of coal, as noted in *Engineering News-Record*, Aug. 16, 1917, p. 332. The towboat was not very efficient, and while the pilots were familiar with the upper Mississippi, they had not previously piloted such a large tow, 550 ft. in length over all. It is stated that notwithstanding these difficulties the trip was successful financially, as well as from a transportation standpoint. These barges were then loaded at St. Paul with iron ore for St. Louis.

Recently the John Deere Plow Co., at Moline, Ill., leased four barges and a towboat from the Government and moved farming implements from Moline to Minneapolis.

The Mississippi Valley Waterways Association has organized a $2,000,000 barge line from St. Louis to New Orleans. After the financing of this line has been effected, it proposes another from St. Louis to Minneapolis.

Federal Hydro-Electric Nitrate Plant Dropped for New Efficient Processes

Results of Recent Research by Chemical Companies Will Immediately Provide Government Plant

A new program has been made by the Ordnance Department of the United States Army for the production of artificial nitrates in a Federal plant, under the $20,000,000 nitrate-supply appropriation made by Congress in 1916 (Section 124 of the National Defense Act of June 3, 1916). At the time of this legislation, it was expected that any processes available would require so much power that a cheap supply, as from a big hydro-electric plant, would be required; and the Interdepartmental Board (the Secretaries of War, Interior and Agriculture) together with a committee of army engineers had started upon the selection of a site. However, new processes, in which cost of power is not a controllling element, have been developed in this country, and have been made available to the Government on liberal terms. Therefore further consideration of hydro-electric sites has been suspended. Announcement of this step has been made through the American Chemical Society in its *Journal of Industrial and Engineering Chemistry*, for Sept. 2 (Dr. C. A. Herty, editor, being a member of the Nitrate Supply Committee).

New American Processes

While water-power sites in the United States were being investigated, agents were studying the technique and cost figure of processes used here and abroad. The reports of Dr. C. L. Parsons, chief chemist of the United States Bureau of Mines, showed that two American processes for the fixation of atmospheric nitrogen as ammonia, and one for the conversion of ammonia to nitric acid, had been brought to a satisfactory stage. The fixation processes were offered to the Government on liberal terms—no compensation at all for munitions work and a royalty of $5 per 2000 lb. of material for fertilizer.

The first of these methods is the synthetic-ammonia process of the General Chemical Co., as developed largely by its engineer, Frederick de Jahn. This company has succeeded in making the preliminary mixture of hydrogen and nitrogen at a cost probably lower than before attained anywhere. It has also forced the direct combination of these elements at lower pressures than considered necessary for the Haber process, and has a production unit in service larger than supposed to be in use at Haber plants in Germany.

The second scheme reported on was the Bucher process, of the Nitrogen Products Co. This produces ammonia but employs cyanides as an intermediate product. The third process (conversion of ammonia to nitric acid) had been developed coöperatively by the Bureau of Mines and the Semet-Solvay Co.; an experimental plant has been in operation by the General Chemical Company.

Recommendations of Nitrate Committee

The Committee on Nitrate Supply, appointed by the Secretary of War, has recommended: (1) That the Government negotiate with the General Chemical Co. for the use of its process; (2) that $3,000,000 be used to build a plant to produce 60,000 lb. of ammonia per day

Surveys for an All-American Imperial Canal

Surveys for a canal wholly on American soil to irrigate 200,000 acres in the Imperial Valley, California, the water to be taken from the Colorado River at the Laguna dam, above Yuma, Ariz., were announced on Aug. 26 as about to be started. The announcement was made by Mark Rose, Holtville, Calif., president, Imperial-Laguna Water Co. The Department of the Interior will participate in the surveys and if it finally approves the scheme the land in question will be withdrawn from the Yuma project and restored for entry under the desert land act. The plan includes a widening of the present Yuma canal between the Laguna dam and the siphon beneath the Colorado River at Yuma; then a new canal to a point on the sand hills near the boundary line, and a deep cut through these hills, to avoid going into Mexico.

Idaho Highway Commission Favors Graveled Roads

The State Highway Commission of Idaho recently went on record in favor of graveled roads through the lava ash soil formation of the Snake River Valley. The action is expected to result in the graveling of the North and South Highway, the Sawtooth Park Highway, the Idaho and Pacific Highway and the Yellowstone Park Highway at points where the natural materials through which the roads are built will not sustain the heavy traffic. William A. Broadhead, chairman of the Highway Commission, said that the state has been spending too much money in grading roads that go to pieces during the hot summer months and again in the winter. The cost of keeping the highways in shape is far out of proportion to the original cost of constructing them. E. M. Booth, state highway engineer, in submitting to the commission figures on cost of constructing and maintaining the roads under the supervision of the state, said that of $1,000,000 spent on the highways since the creation of the commission, $600,000 had been used in grading and that $100,000 had been expended in maintaining dirt roads built.

and that it be located preferably in southwestern Virginia; (3) that at least $600,000 be used for building an ammonia-oxidation plant producing the equivalent of 24,000 lb. of 100% nitric acid per day; (4) that the War Department proceed with the construction of these plants at the earliest possible moment; (5) that the Government negotiate with the Nitrogen Products Co. for the use of its process and that $200,000 be allotted for its industrial development; (6) that $100,000 be allotted for the active investigation of processes for the industrial production of nitrogen compounds useful in the manufacture of explosives or fertilizers—under the supervision of the War Department; (7) that the Government promote the installation of byproduct coke ovens, for the recovery of ammonia and toluol, by directing priority in production and in transportation of materials and parts; (8) that more extensive installation of fixation processes or water-power development be postponed until the recommended plants are in operation or further need arises; (9) that there should be an immediate accumulation and permanent reserve of 500,000 tons of Chilian saltpeter.

ACTION BY SECRETARY OF WAR

The report of the Nitrate Supply Committee was approved and the Secretary of War has directed the chief of ordnance to carry out the first six recommendations. The Ordnance Department of the Army has taken over orders already placed by the General Chemical Co. for apparatus. Plans for plant and buildings have been practically completed by the General Chemical Co. The J. G. White Engineering Corporation has been engaged for the remaining engineering work and for construction. Gano Dunn, president of this corporation, is a member of the Nitrogen Products Committee. As the construction of the oxidation plant is less extensive work, it has been postponed to secure latest experimental results.

Canadian Northern Railway Is Building Montreal Station

Work is being pushed on the excavation for the temporary station at the terminal of the Canadian Northern Ry. in Montreal. More surface activity is seen than at any time since work on the Mount Royal Tunnel and Terminal project opened, there being during July and August three steam shovels, two 8-car trains of dump cars and numerous wagons opening up the site. Two whole city blocks, between Lagauchetiere and Dorchester Sts., are being excavated. But the present station building as at present planned is a temporary structure occupying less than half of the area of the terminal site. The rest of the cut will remain open and the five track platforms will be protected by umbrella sheds. The portal of the Mount Royal tunnel is at Dorchester St., and from here the two two-tunnel tracks will fan out to five for the station yard. Eventually the whole site will be occupied by combined station and office or hotel buildings, and two tracks will continue south down the right-of-way which the company owns leading directly to the waterfront.

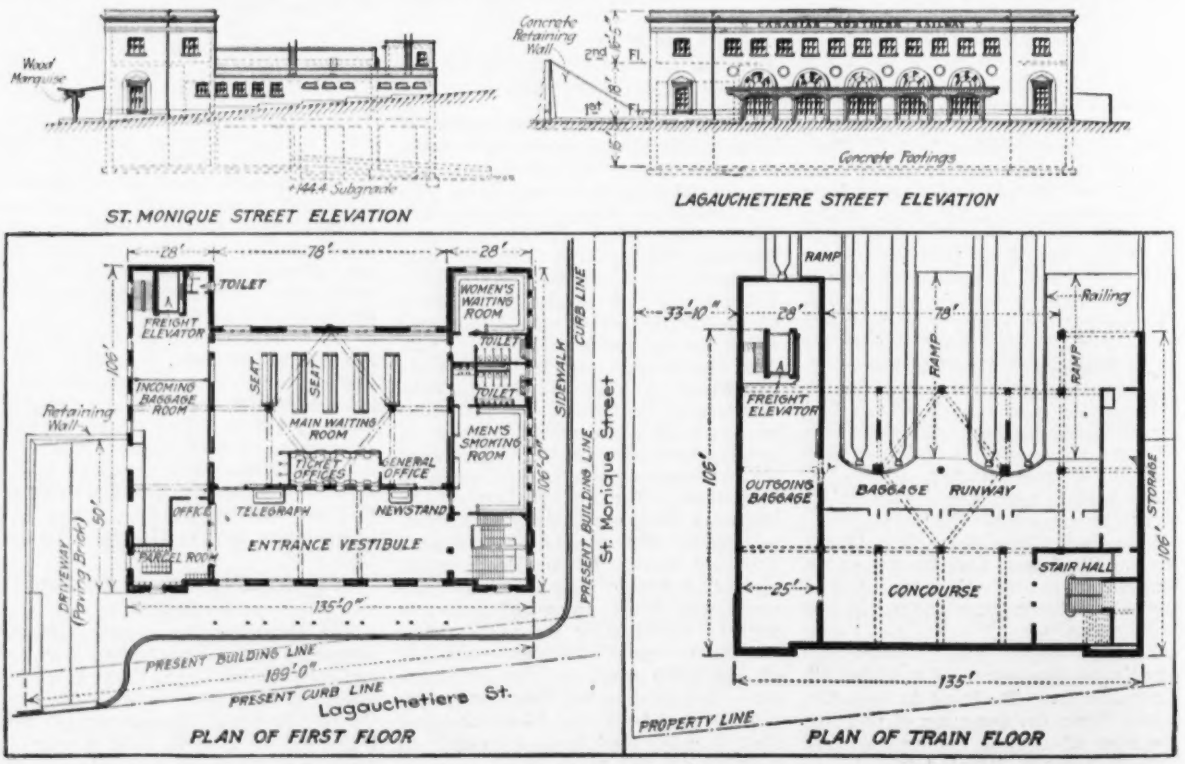
There is 260,000 cu.yd. of earth and 18,000 yd. of rock to be removed from the terminal site—20,000 yd. of earth being at the temporary-station building. The contract for the station proper was let to Norcross Bros. and the yard cut to Angus Sinclair & Co. The spoil from the building site is loaded by a steam shovel directly into the wagons in the pit, and the loads are snatched up an incline by an electric hoist. The wagons haul to Victoria Bridge, where the city is dumping for river-front improvements.

The material from the yard cut is loaded by steam shovels into 6-yd. cars, and these are hauled by dinkies to a point over the east portal of the tunnel under Mount Royal. Here the spoil is dumped into a baffled chute, discharging into spotted 12-yd. tunnel cars. The tunnel track and electric-power systems are complete from the east portal to beyond Cartierville. There are three dump trains now running to carry the spoil to a fill, where the Cartierville yards are to be. No other traffic is being handled as yet through the tunnel.

The station will have concrete walls, stuccoed on the exterior; the interior will be plaster on terra cotta tile. Warren & Wetmore, of New York City, are the architects; J. G. Brown is chief engineer of the Mount Royal Tunnel and Terminal Co.

Signal Engineers to Hold Meeting

The annual convention of the Railway Signal Association will be a two-day meeting at the Traymore Hotel, Atlantic City, N. J., on Sept. 18 and 19.



THE CANADIAN NORTHERN TEMPORARY STATION IN MONTREAL WILL BE ATTRACTIVE STRUCTURE

Price of Pavement Reduced 24 Per Cent.

Resolution in Los Angeles Council Results in Lower Bid for Top Materials

The controversy in Los Angeles between the City Council and the Warren Brothers Co. reached a climax Aug. 22, when the company announced a reduction of the price of material, including the patent royalty, from $1 to 76c. a sq.yd. This is apparently the result of a resolution introduced in the Council calling for an estimate by the city engineer of the cost of building the addition to the city asphalt plant to turn out the paving mixture.

COST OF ADDITIONAL PLANT ESTIMATED

A. C. Hansen, city engineer, filed a report with the Board of Public Works in answer to the resolutions, stating that it would cost $87,000 to build an addition to the municipal asphalt plant capable of producing the paving mixture on a scale proposed.

The land would cost $30,000, the plant $55,000 and the equipment $2000. A site can be obtained adjoining the present plant. A rock, gravel and sand producing plant can be obtained by the city at the cost of $25,000 additional, the city engineer reported.

Illinois Highway Paper Discontinues

For three years the Illinois State Highway Commission has published a paper entitled *Illinois Highways*. This has been discontinued owing to the change in organization by which the highway department comes under the new State Department of Public Works and Buildings. It is expected that a state publicity service will be organized to keep the people informed as to the activities of the nine departments which now constitute the civil administration of the state.

Only Segment Block Shut Out from Detroit Sewers

The action of the Detroit City Council on sewer specifications, noted on pages 386 and 428 of our issue of Aug. 30, was not so bad as we understood it to be from reports that reached us and have since proved to be incomplete. The specifications have been opened to monolithic concrete and to both concrete and vitrified clay pipe, instead of being restricted to brick. Possibly concrete segment blocks can also be used, as there is uncertainty whether the City Council intended to prohibit anything except vitrified clay or shale segment block.

New Manhattan Subway Opens This Week

Broadway Line Will Operate Through Canal Street Subway South of Fourteenth Street

Part of the new Broadway subway of the New York Municipal Lines in New York City will be in operation before this issue reaches its readers, having been opened to traffic with appropriate ceremonies on Sept. 4. This line, on which trains will operate between the Fourth Avenue, Brooklyn, subway, and Fourteenth Street and Broadway, Manhattan, by way of Broadway, Canal Street and the Manhattan Bridge, will be the first considerable underground section of the new Rapid Transit system to be placed in operation in Manhattan itself. Its operation has been preceded by the opening of the Steinway subway from the Grand Central Terminal to Long Island City, a small part of which is in Manhattan, and by the inception of a shuttle service between the Pennsylvania Station and Times Square, on a short section of the new Seventh Avenue subway.

Train service to Fourteenth Street will be followed before the end of the year, it is announced, by service uptown to Time Square over the Broadway line and by a shuttle service south on Broadway from Canal Street to Whitehall Street. This shuttle service will be replaced by through service early in the year between Times Square and Brooklyn by way of the Whitehall-Montague Street tunnels. On the completion of the new tunnels at Sixtieth Street from Manhattan to Long Island City, the New York municipal subway will be operated through from Brooklyn by way of the Whitehall Street tunnels and the Manhattan Bridge at Broadway and Seventh Avenue, across Fifty-ninth Street, under the East River and on the Long Island elevated lines to Astoria and Corona.

The Public Service Commission for the First District of New York State, under the direction of which the subway construction is being carried out, estimates that many thousands of persons living in Brooklyn who have been paying 20c. a day to reach their work will be saved 10c. a day when the first part of the new route to Fourteenth Street is put in operation.

Engineer Officers' Reserve Corps Assignments

The following-named officers of the Engineer Officers' Reserve Corps now on duty at the engineer training camp, in the vicinity of Washington, D. C., are relieved from duty at that place and will report at the proper time at the divisional training camps indicated below for duty with the engineer regiments and engineer trains of the National Army at those places:

To Atlanta, Ga.

For assignment to the Three Hundred and Seventh Engineers, Atlanta, Ga.: Majs. Harrison C. Mower and Eugene Kelly, Capts. William D. Kendrick, Harry W. Hill, Charles F. Lewis, William S. Pottinger, Jr., Hobart B. Baird, James B. Abbott, Jr., William C. Caye, Jr., Thomas B. Catchings, Merritt W. Dixon, Jr., Edward C. Lane and James W. Houseal; First Lieuts. Willson Y. Stamper, Jr., James P. Woodson, Reading Wilkinson, Isham F. Witherington, Carlston E. Shaffer, William Woodhull Moore, H. Hunter Smith, Julius D. Brown, Marvin L. Davis, Neil Houston, Edward S. Allen and Wert H. Peace; Second Lieuts. James H. Claxton, James M. Kelley, Walter R. Boyd, Delmont O. Hatch, Philip Francis Shannon and George B. Jurden.

To be attached to the Three Hundred and Seventh Engineers, Atlanta, Ga.: First Lieuts. James G. Parks, Henry W. Clark, John E. Deegan, John P. Hallowes, Benjamin H. Woodruff, Henry C. McGowan, David N. Milhan, William M. Meredith, Howard D. Pope, Grover C. Prowell, Henry S. McGee and James C. Lee; Second Lieuts. Robert W. Smith, Andrew O. Jackson, William W. Owens, Jack N. Peebles, Harry G. Farris and William F. Green.

For assignment to the Three Hundred and Seventh Engineer train, Atlanta, Ga.: Capt. Curtis Bates Goode, First Lieut. Clement Coote Brown, Jr., Second Lieut. Roberts J. Mann.

To be attached to the Three Hundred and Seventh Engineer train, Atlanta, Ga.: First Lieut. Andrew Y. Holgdon, Second Lieut. William F. Codd.

To Ayer, Mass.

For assignment to the Three Hundred and First Engineers, Ayer, Mass.: Majs. Harry F. Cameron and Richard M. Lawton, Capts. William F. Hussey, Robert Lee Whipple, Arthur L. Shaw, Hugh J. Batterley, Arthur W. Waldron, Elwin S. Warner, Maurice H. Pease, Norman D. Dean, John F. Doran and Howard S. Porter; First Lieuts. Eric C. Benedict, Edward J. Kiely, Jr., Walter R. Morse, John J. Devlin, Daniel H. B. Starr, Gordon C. Day, Ernest J. Weaver, Alfred H. Codaire, Cedric Powers, Charles J. Kittredge, Milton C. Mapes and Alexander C. Peters; Second Lieuts. Joseph F. V. Grady, Bradley W. Batholomew, Frank W. Garran, Arthur E. McDonald and William E. Bowler.

To be attached to the Three Hundred and First Engineers, Ayer, Mass.: First Lieuts. Thomas W. Bailey, Josiah B. Rutter, Stanley W. Merrill, Lewis E. Wyman and Cornelius Callaghan.

Further assignments will be noted in next week's issue.

Aviation Camp Contract Awarded

John W. Thompson, general railway contractor, 510 Boatmen's Bank Building, St. Louis, Mo., has been awarded the contract by the United States Government for the construction of an aviation camp at Fort Worth, Tex., for the use of the Canadian Government in training aviators. The work on the camp will begin immediately. The camp will be about twice as large as the camp at Belleville, Ill., and the total cost is estimated at between $3,000,000 and $4,000,000.

PERSONAL NOTES

J. D. HOFFMAN, who has been in charge of the department of mechanical engineering, at the University of Nebraska, since 1911, has become professor of practical mechanics at Purdue University. His successor at the University of Nebraska has not been named. The chair may remain unoccupied for a year or two owing to the reduced number of advanced students.

PROF. C. R. RICHARDS, who has been professor of mechanical engineering at the University of Illinois, and recently acting dean of the College of Engineering, has become dean since the resignation of W. F. M. GOSS.

GEORGE EDGECOMB, of the firm of Edgecomb Bros., Binghamton, N. Y., has completed the road contract at East Branch, Delaware County, N. Y., for his firm and is at present engaged in road construction at Camp Upton, Yaphank, Long Island.

I. M. BROWN has been appointed acting engineer, maintenance-of-way, of the Indianapolis Terminal Division of the Cleveland, Cincinnati, Chicago & St. Louis Ry., with headquarters at Indianapolis, vice C. F. HINCHMAN, who has been granted a leave of absence.

R. T. BROWN, formerly highway engineer of Davidson County, North Carolina, has been appointed assistant engineer in the South Carolina State Highway Department. Mr. Brown had been employed by the North Carolina Geological and Economic Survey as locating engineer on highway work, and then for the three years following was county engineer and superintendent for Orange County, North Carolina, having charge of the construction of roads and bridges under a bond issue.

CAMILLO WEISS, at present with the Guerber Engineering Co., Bethlehem, Penn., has been appointed instructor in structural engineering at the University of Illinois. Previous to his connection with the Guerber Engineering Co., Mr. Weiss was connected with the bridge and construction department of the Pennsylvania Steel Co., Steelton, Penn.; with Lockwood, Greene & Co., architects and engineers, Boston, Mass., and then for two years was a research fellow in the engineering experiment station at the University of Illinois.

W. B. WILLIAMS, who for several years has been engaged in the drainage contracting business, mainly dipper and dry land dredge work, has finished work at Oviedo, Fla., and now has a contract for 33 miles of drainage canals and ditches at Limestone, De Soto County, Fla., having headquarters at St. Petersburg, Florida.

MAJ. FRANK B. MALTBY, construction engineer, Day & Zimmermann, Philadelphia, has been assigned to take charge of construction work on Governors Island. Major Maltby was at one time with James Stewart & Co., contractors, New York, and was then associated with Gahren & Dodge as chief engineer. For some years he was engaged in railroad construction in the Middle West, becoming principal assistant engineer of the Illinois Central R.R. in charge of construction of lines in Iowa. He was also associated with the Mississippi River surveys, and later with municipal developments and improvements in the vicinity of St. Louis, and with irrigation work in Texas.

E. B. DARLINGTON, chief engineer and superintendent of the Salmon River irrigation project, Idaho, has been appointed chief engineer of the Twin Falls Northside Land and Water Co. irrigation project, Idaho, succeeding C. R. BURKY, resigned to attend the Officers' Reserve training camp at Presidio, San Francisco. Mr. Darlington will assume his new duties about the middle of September and will be stationed at Jerome, Idaho.

DR. J. L. POMEROY, who recently resigned as health officer of Los Angeles County, California, to accept a commission as army surgeon, has returned from his station at Fort Riley on account of poor health and has been reappointed to the position formerly held by him.

JAMES C. NAGLE has been appointed dean of engineering and professor of civil engineering in the Agricultural and Mechanical College of Texas, succeeding E. W. SPENCE, whose death occurred in June and was noted in these columns recently. Professor Nagle is a graduate of the University of Texas, and has been professor of civil engineering in the Agricultural and Mechanical College of Texas for about 20 years, and since 1911 has been dean of engineering. Resigning from this position in 1913 to become chairman of the Texas Board of Water Engineers, he gave up his last position to resume his professorial duties. Professor Nagle is the author of a field manual for railroad engineers. He is a past president of the Texas Association of Members of the American Society of Civil Engineers, past president of the Texas Academy of Science and a major in the Engineer Officers' Reserve Corps.

E. JACK SMITH, who for the past 18 months has had charge of the highway work in Meigs County, Tennessee, has been placed in charge of the engineering work on highways in Fentress and Morgan Counties, Tennessee.

ERLE B. DUDLEY, construction engineer at the Bunker Hill and Sullivan concentrators at Kellogg, Idaho, has been commissioned captain in the Engineer Officers' Reserve Corps.

P. M. GEREN, formerly engineer and salesman in charge of the San Antonio, Tex., office of the Trussed Concrete Steel Co., of Youngstown, Ohio, has received a commission as first lieutenant in the Engineer Officers' Reserve Corps, and has been ordered to duty as instructor at the second camp to be held at Leon Springs, Texas.

ORIN M. DARLING, surveyor and civil engineer, Fort Wayne, Ind., is at present in Lakewood, N. J., in charge of the engineering on the laying of 22,000 sq.yd. of concrete pavement.

GEORGE W. BOWERS has received a leave of absence from his position of assistant engineer of construction, filtration department, Cleveland, Ohio, to act as assistant engineer in charge of the water-supply under R. WINTHROP PRATT, consulting engineer for the Government, at Camp Sherman, Chillicothe, Ohio.

J. B. MCCLAIN is at present in charge of the construction of four new 100-ft. turntables to replace the 80-ft. tables which were rendered obsolete by the purchase of 12 new Mallet type locomotives by the Seaboard Air Line Ry. The new engines will be 108 ft. long overall, requiring these new tables, which are longer than anything at present in use in the South. The tables will be located at Richmond, Va.; Raleigh, N. C.; Hamlet, N. C., and Monroe, North Carolina.

A. S. ZINN is at present assistant to the general superintendent of construction for A. Bently & Sons Co., Toledo, Ohio, contractors for the cantonment at Chillicothe, Ohio. Mr. Zinn has been assistant engineer of track elevation for the Chicago & Western Indiana R.R., division engineer of the Chicago, Rock Island & Pacific Ry., and construction engineer for the Michigan Central R.R. In 1906 Mr. Zinn went to the Panama Canal as resident engineer of the central division, and in 1913 was appointed division engineer. From 1914 to 1916 he was consulting engineer for the Republic of Panama.

PROF. ROBERT GIBBES THOMAS, of the Military College of South Carolina, has been appointed a member of the State Highway Commission of South Carolina.

BENJAMIN F. LATTING, who for the past few years has been employed by the Indiana Bridge Co., Muncie, Ind., and engaged in consulting work on highway bridges, has received the appointment as aëronautical mechanical engineer, Signal Service at Large, Washington, D. C., and is at present designing structural steel work for the use of the army.

FRED W. BILTZ, formerly in the chief engineer's office of the Philadelphia & Reading Ry., at Philadelphia, has been transferred to the position of assistant supervisor of the Shamokin Division of the same road, with headquarters at Tamaqua, Pennsylvania.

CHARLES BARTHOLET, formerly with the Washington State Highway Commisison and later with the Public Service Commission of that state on grade-crossing elimination work, has been appointed assistant state hydraulic engineer, with headquarters in North Yakima.

BLACK & VEATCH, Kansas City, Mo., are consulting engineers to the Constructing Quartermaster of the National Army cantonment at Little Rock, Ark. R. E. SPEAR is acting as division engineer for this company, having resigned from the city engineering department of Flint, Mich., to accept this work.

COL. R. K. HALE, of Richardson & Hale, editor of the *Journal* of the New England Water-Works Association, has been placed as second in command of the 101st Regiment of Field Artillery.

R. E. WHITNEY, formerly with Weston & Sampson, consulting engineers, has been appointed first lieutenane in the Sanitary Engineers' Reserve Corps.

HUGH B. HOLMES has resigned as chief engineer of the Kansas City, Mexico & Orient R.R., to become associated with Cloverdale & Colpitts, consulting engineers, New York City. W. W. COLPITTS was Mr. Holmes' predecessor as chief engineer of the Orient, leaving Kansas City in 1913. Mr. Holmes has been 17 years with the Orient, beginning his connections as rodman—eight years of this time was spent on the work in Mexico.

OBITUARY

ISAAC CHAPMAN, contractor, of Walla Walla, Wash., died in that city recently.

GEORGE BROMLEY KIRKPATRICK, until recently director of surveys for the Ontario Government, died last week at Toronto. Mr. Kirkpatrick was the first president of the Association of Ontario Land Surveyors.

HENRY SOUTHER, former vice president of the Ferro Machine and Foundry Co., and at one time consulting engineer of Cleveland, Ohio, died Aug. 15 in the hospital at Fort Monroe. A short while ago Mr. Souther had been commissioned as major in the United States Signal Corps and had been serving at the time of his death as engineer in charge of the Langley Aviation Field.

ARTHUR KNEISEL, national treasurer of the American Association of Engineers, died in Chicago on Aug. 17, 1917. Mr. Kneisel was one of the original promoters of the association and had been secretary up to this year. Graduating from the University of Kentucky, he came to Chicago about 15 years ago and was engaged as telephone engineer and patent attorney. At the time of his death he was president of the Utilities Development and Sales Company.

CHARLES B. STOWELL, formerly city engineer and superintendent of the sewer department, Rockford, Ill., died Aug. 10. Mr. Stowell was well known for his geological research of the rocks in the vicinity of Rockford, and at various times had served as a member of the Illinois State Examining Board of Structural Engineers.

Notes from

MAKERS OF PLANT AND EQUIPMENT

The Vulcan Steel Products Co. held its annual banquet in the McAlpin Hotel, New York City, Aug. 17. At the last banquet there were only about 60 people in the company, while this year the attending employees numbered 175. The banquet was held somewhat in advance of the usual date because of the fact that three members of the organization were due to leave Aug. 19 for the Far East. D. D. Irwin, manager of the Far East division, has been in New York arranging for this expansion of the company's interests in Japan, where increased commercial and manufacturing activities have created a steadily growing market for American products. The party that will shortly leave for Japan is made up of E. J. Parker, sales manager of the engineering and machinery division, who will organize a Japanese department at Yokohama; Joseph Bayan, who will care for the interests of the Vulcan Trading Corporation in Japan; and D. D. Irwin, who has general charge of the Far East division. Chauncey Holmes, assistant manager, remained in Yokohama to care for the interests of the company's clientele during the absence of Mr. Irwin. A. Micoli is also leaving New York for South America. He will travel through Argentine, Brazil and Uruguay in the interests of the Vulcan Trading Corporation.

The Blaw-Knox Co., Pittsburgh, announces that T. M. Avery, one of its New York City representatives, is leaving for the Pacific Coast to take charge, temporarily, of the San Francisco office. Edward M. Ornitz, San Francisco representative, has joined the Engineer Officers' Corps as first lieutenant.

The Annual Congress of Purchasing Agents, under the auspices of the National Association, will be held at Pittsburgh, Oct. 9, 10 and 11. The program includes business sessions for the mornings and inspection of industrial works during the afternoons. All purchasing agents, as well as others interested, are welcome and expected to attend and participate in the activities of the convention.

The American Locomotive Co. announces the promotion of E. C. Fisher to the position of manager of the company's Pittsburgh works.

The Ransome Concrete Machinery Co., Dunellen, N. J., has incorporated anew with larger capital comprising $1,000,000 capital stock, $500,000 cumulative preferred stock and $500,000 common stock. The new corporation takes over the business and plants of the old Ransome Concrete Machinery Co., of New York. It will enlarge and further expand its business until it will cover the entire line of building contractors' equipment, contractors' machinery and road builders' machinery and equipment. The company has been in business for more than 25 years.

The Ingersoll-Rand Co., New York City, came out winner in a drilling contest held recently at Tonopah, Nev. There were 42 contestants, including representatives of all the manufacturers of self-rotating hand hammer drills. The company's "Jackhamer" (Type BCR-430) won first, third and fourth places. The tests were drilled in Rocklin granite, and each contestant was allowed eight minutes in which to connect his hose and drill as great a footage as possible. The winning "Jackhamer" put in 61⅞ in. The next best performance was 58⅞ inches.

The T. L. Smith Co., of Milwaukee, has recently appointed as its New York agent the Contractors' Trading Co., 232 Fulton St., New York. Messrs. Wentink, Watts and Clarke are the active partners in the company, and they will handle the complete line of Smith Co., Chicago, concrete mixers and pavers.

C. R. Dodge, formerly of C. R. Dodge & Co., of New York, representing manufacturers of construction equipment, has closed his New York office to accept a position as the manager of the Philadelphia office of the Lakewood Engineering Co., in the Widener Building.

The Vulcan Steel Products Co., New York City, has engaged Dr. Roy P. MacElwee, head of the department of physics of the College of the City of New York, to deliver a course of 15 lectures on international trade to its employees. Mr. Kafka, president of the Vulcan company, intends to have these talks popular yet technical, in order to show every individual how to do his work better and make it more interesting. At the close of the lecture series, an examination will be held and future advancement will be based to a great extent upon the standing secured.

The Torcrete Shipbuilding Co., recently organized at Chicago, is now negotiating for a suitable yard location near Detroit, where, according to the Portland Cement Association, it is proposed to begin at once the building of a 1200-ton cargo steamer for Great Lakes service. Additional yards near New York, New Orleans and Los Angeles will be established later. All of these plants will build reinforced-concrete vessels after what is known as the Torcrete system. Technically, Torcrete is a combination of steel and concrete, the practical application of which results in a laminated hull inlaid with steel reinforcing. Torcrete is applied under air pressure after a new process and with a machine, both of which are inventions of Carl Weber, president of the Torcrete Shipbuilding Company.

The Walter A. Zelnicker Supply Co., St. Louis, has just secured the services of J. C. Bryan, formerly with Manning, Maxwell & Moore, Inc., as Southwestern representative of the Ashcroft Manufacturing Co., the Consolidated Safety Valve Co., the Hayden & Derby Manufacturing Co. and the Hancock Inspirator Co. Mr. Bryan will be associated with the equipment department of the Zelnicker company.

KEROSENE HEATERS SOFTEN ASPHALT PAVING AND HEAT TOOLS AND MATERIALS

APPLIANCES AND MATERIALS

New Concrete Mixer Has Improved Drum

A new concrete mixer, to be known as the "Blaw-Ransome," is announced by the Blaw-Knox Co. It was designed by A. W. Ransome, who recently became manager and chief engineer of this concern.

The distinctive feature of the new mixer is the design of the drum. Both ends in shape are truncated cones. The cylindrical portion of the drum is only 2 ft. in width. Blades are a new design intended to give a spading and overturning movement and at the same time to promote fast discharge. Easy cleaning was also considered. The drum is of sheet steel. The steel frame is built of 3 x 3 x ⅜-in. angles and 4-in. channels, gussetted and sway-braced. Trackways are wrought steel (welded) and turned while in place on the drum. Chain drive is used, and a segmental steel sprocket on the drum. This new mixer is equipped with 4-hp. gasoline engine and a low-charging platform or power side-loader. It is being manufactured in one size only for the present—10 cu.ft. capacity.

Kerosene Paving Heaters Burn Gas Vapor

Hand-operated kerosene heaters for use in softening old asphalt paving to be repaired, and for heating the tools used in asphalt paving construction and repair, made by the Alger Supply Co., Peoples Gas Building, Chicago, are a recent development in apparatus for street work. The oil is burned as a gas vapor and not as a spray. This requires a pressure of only 10 to 15 lb., which gives a hot blue flame with an oil consumption of about one gallon per burner per hour. The pressure is maintained by a hand pump.

The "Pluto" machine, shown in one of the accompanying illustrations, is for softening the surface of old asphalt. It has a steel frame mounted on wheels, and carrying a heater pan which covers 36 sq.ft. The heater is hinged to the uprights of the frame, and for transportation it is raised to a vertical position against them by means of cables and drums on a shaft operated by a crank handle. The machine can be hauled by an automobile. There are six Chausse kerosene burners or torches, each giving a 6-ft. flame. The torches are started by heating up with an auxiliary hand torch, or by burning oil-soaked paper in the torch. The frame carries two fuel tanks, so as to provide for continual operation. When the main (35-gal.) tank is to be filled the auxiliary (18-gal.) tank is switched into service. The machine is balanced so that one man can handle it.

A special form of the "Pluto" machine is used for heating the old paving along car tracks. This has the pan hinged to the side of the frame (outside the wheel), so that the machine can operate close to the track without interfering with traffic. The pan has three burners and covers 18 sq.ft. For use in repairing narrow ruts, there is a machine with a pan 6 ft. long, but only 9 in. wide, having two burners.

For heating the tools and material used in asphalt and other bituminous paving work (both construction and repair) there is made the "Phisto" machine, which is also illustrated. This has three kerosene burners, similar to those on the asphalt heaters. The tampers are inserted at the rear of the box. On top are supports for three buckets of binder "dope" and three shovels, which are thus kept hot.

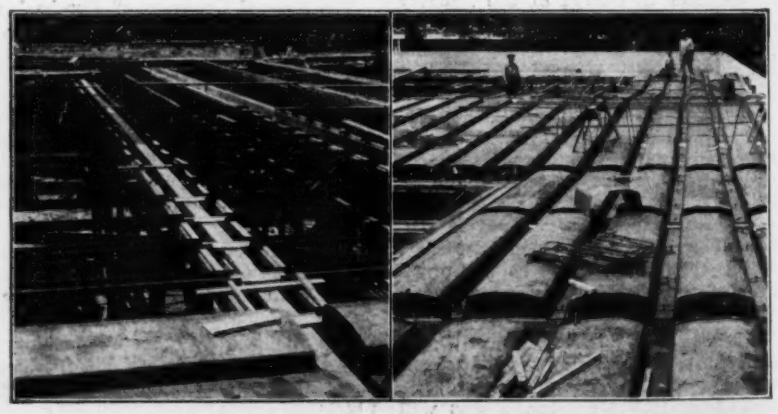
Steel Forms for Concrete Buildings Require Minimum Shoring

A new system of steel forms for the construction of reinforced-concrete buildings has been developed by M. S. Ambursen and is being sold by the Uni-Form Co., 10 High St., Boston, Mass. The distinguishing feature of the system is that the whole form structure is of steel, being made up of channels and arch plates, coupled by bolts and spreaders. All parts are removable except the spreaders and a few small nuts. Shoring supports are required only on 10-ft. centers.

These forms are standardized in uniform units of three lengths. A 6-in. channel in 6-, 8- and 10-ft. lengths serves for all conditions, but the depth of the arch plate or pan varies from 6 to 12 in. (or deeper if required) according to the load and span. These plates are of 14-gage mild steel. The pans come in 6-, 8- and 10-ft. lengths, so that any span from 12 to 30 ft. can be covered.

The accompanying illustrations show how the channels are first placed in position and then the arch plates set up with the edges of the plates in the channels and held in proper place by the spreaders and bolts. The forms can all be removed as soon as the concrete is set (that is, about 48 hours after pouring) and the shoring may be left in place undisturbed as long as required as a temporary support for the green concrete. The pans are made somewhat narrower than the actual distance employed between the flanges of the channels; this causes the pans to spring back and release themselves from the concrete when the channels are removed.

Reinforcement may be held in the desired position, with reference to the bottom of the joist, being supported by and wired to the spreaders, making a very simple arrangement.



STEEL CHANNELS SUPPORT ARCH PLATES IN NEW FLOOR-FORM SYSTEM